Tony Yuan

Physical Mechanisms Behind Light and Gravity in the Universe

Gazing at the Starry Sky from the Shoulders of Giants

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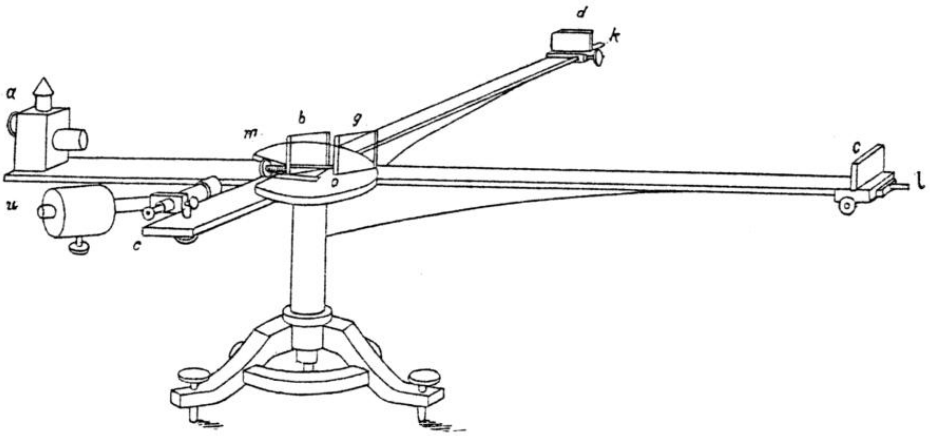

The truth may be delayed, but it will not be absent forever.

Preface

In the natural world, light and gravity are two widely prevalent and significant phenomena. They not only provide humans with rich information about the universe but also play important roles in scientific research. Although light and gravity may not appear to have a direct connection on the surface, can we find a correlation between them? The discovery of gravitational waves provides us with new clues. The LIGO gravitational wave detection experiment successfully detected gravitational waves, which are believed to be caused by disturbances in the gravitational field and propagate at the speed of light. This raises an intriguing question: do light and gravitational waves share a medium for energy transmission? Furthermore, can we establish a unified physical model to explain the physical mechanisms of electric fields, magnetic fields, and gravitational fields, as well as their relationships? This study focuses on these questions, thoroughly analyzes the phenomena of light and gravity, and ultimately establishes a unified field theory framework to comprehensively understand the fundamental matter and energy in the universe.

I didn't expect to start researching basic physics theories myself. I remember watching a documentary about Einstein on TV once. In his later years, Einstein had doubts about his own theories and even burned some of his manuscripts. His behavior puzzled me. Why would he do that? This sparked my interest in understanding the theories of special and general relativity.

In 2020, I began participating in some scientific forums and sought advice from scholars there. However, as I delved deeper into my studies, I discovered many things that I couldn't explain. As a wireless communication engineer, my professional background made it hard for me to accept a journey filled with uncertainties. So, I kept looking for "masters" of relativity. I did encounter some who were recognized as such in these scientific forums, but I still found their theoretical analyses to be very restrictive. In some simple physical scenarios, they would run into contradictions. This left me disappointed.

During this time, I also started exploring models for calculating planetary orbits. I

attempted to calculate the precession of Mercury, wondering if it could be done just by solving a particular equation. Through some trials, I surprisingly managed to calculate a value of 43" per century. This gave me the impetus to delve deeper. Looking back now, it almost feels like fate because the data I used for calculations were from a Chinese website, and some of the data on Mercury was incorrect. However, it was this erroneous data that led me to the "correct result."

I began sharing my findings with others. A friend of mine, a colleague from Nokia, reviewed my paper and thought my mathematical derivations were correct. However, he pointed out that it lacked physical significance. I continued seeking people who could review my ideas. Luckily, someone on the scientific forum told me that Professor Richard from the Austin Institute of Physics was a highly respected professor in astrophysics. I wrote to him, and he promptly replied—a surprise, as it's rare to receive a reply from a professor in China. I soon received an email from Professor Richard, my first contact with a Western professor.

He was very kind, writing a five-page derivation that proved my ideas were incorrect. Yes, he did it. He provided the correct analysis that helped me move away from my misconceptions. Looking back, I'm very grateful to him. I got the answers I needed, so I put aside my physics research and returned to my work. However, about half a year later, I unintentionally started thinking about gravity again.

I continued asking questions in the scientific forums, it is a very passionate scientific forum. I like the people in it; they try to convince me, even though they may not seem friendly, but they always revolve around specific scientific issues rather than anything else. There was a guy who claimed to be a chemist whom I really liked. Perhaps one day he will come across this text. I kept thinking day and night, during walks, meals, and even while sleeping. I really enjoy thinking, and I like to think while doing other things. I also hope to show some tolerance towards such individuals who might not seem serious but are actually working hard.

One morning, as I woke up, I seemed to have found an answer. I immediately started writing a program in bed to verify it. This time, all the astronomical data I used came from NASA, provided by Richard. I used the program to simulate the process of time domain integration, calculating the orbital positions and velocities of planets at each moment. To my surprise, I calculated a precession of 43" for Mercury. I cried at that moment, feeling like a child. I had found the answer.

I quickly wrote to Professor Richard about my discovery, which surprised him too. He asked

me to send him the program. I sent it to him, but the first time I sent an .exe file, which he said wasn't what he wanted. I realized he needed the source code, so I organized the code and sent it to him again. After about a day, I think (I need to check the emails again), he replied, acknowledging that my calculations were correct but offering some advice. He suggested I conduct simulations in 3D to get closer to reality.

It took me a few days to write the 3D software, and after further intermittent optimizations, the results I calculated matched the solar system planetary orbit data released by NASA. I had many discussions with Professor Richard, who commended my work. He believed it was a theory running parallel to general relativity but advised me that since general relativity already existed, there was no need for another theory. Yes, he advised me to give up.

However, I believed that there were some issues with general relativity, especially regarding the speed of gravity. I raised this concern with him, but his explanation didn't satisfy me, especially regarding the gravity speed issue. The EIH equation assumes a very large speed for gravity but also equates it to the speed of light, which is contradictory. The speeds of celestial bodies are not negligible, and I hoped the professor could provide a reasonable explanation, but his answer fell short.

Our biggest disagreement with Professor Richard was about gravity speed. As for the mathematical description of spacetime curvature, I didn't object; it's just a model for mathematical calculations. We also disagreed on the calculation of Venus's orbit. The professor believed Venus had undergone significant impacts, leading to results that differed from astronomical observations. However, my calculated results matched astronomical observations, and I didn't need an explanation involving impacts; such an explanation seemed no different from invoking divine intervention.

To this day, our discussions on the topic of gravity have become more difficult and infrequent. At the end of a book, I shared an email from him saying, "There are clear conflicts of interest between us." Academician Li Tibai from Tsinghua University's Center for Astrophysics also reviewed my theory, affirming my work. However, we couldn't reach an agreement on the speed of gravity at the time. Academician Li believed the viewpoint of spacetime curvature in general relativity was incorrect but accepted that the speed of gravity equaled the speed of light. I had the privilege of having several discussions with him in his office, but we couldn't come to a consensus.

I turned my theories into a paper and started submitting to physics journals, but apart

from journals like Physics Essays and GED that allow challenges to relativity, all other SCI physics journals chose to reject it. Even when reviewers provided supportive comments, they were ultimately overshadowed by strong opposition from other reviewers.

Especially in Chinese SCI physics journals, their defense of relativity has reached fanatic levels. This continued intermittently for three years, with most of my interactions coming from ResearchGate and Academia.edu, two excellent scientific exchange platforms. At the end of 2023, I had the idea to write a physics book.

During the spring in China, I started this work, which is the book you are now seeing. I reviewed the great physics experiments of the past few centuries, especially optical experiments. I found that these experiments had not been perfectly resolved, which does not align with the logic of an engineer; upgrading phenomena directly to principles is a dangerous act. The foundations of special relativity, "invariant speed of light," and quantum mechanics' "complementarity principle" fall into this category.

So, I began studying from the reflection and refraction of light. The classical Fresnel theory is only suitable for calculations and does not reveal the true nature of physics. I started researching and was deeply drawn to the Fizeau experiment. However, I only found explanations based on SR for this experiment, which is an approximate conclusion based on the premise of a medium velocity $v << c$, and it is not valid when v is not negligible.

Therefore, I attempted to prove the conclusion of the Fizeau experiment starting from classical physics theories. I succeeded and also performed simulations on a computer. My years as a software engineer have been tremendously helpful in scientific research. I find it hard to imagine how research would be conducted without computer program simulations. The final results of the simulations were entirely consistent with my deductions. I proved the conclusion of the Fizeau experiment and included the source code in the book.

The Fizeau experiment can be considered a key to understanding the microscopic universe. This marked the beginning of my magical scientific journey in 2024. This year was destined to be extraordinary for me - MMX, the Fizeau experiment, explanations of stellar aberrations, light reflection and refraction, research on Lorentz transformations and the physical mechanisms behind special relativity, study of electric and magnetic fields, research on the Sagnac effect, and finally, research on double-slit interference, all completed in this year.

I have included all this content in this book, along with research on gravity and gravitational waves from previous years. I proposed a unified field theory based on XTON, which can explain phenomena of light and gravity in the universe. However, it challenges

both special and general relativity, quantum mechanics, and classical physics. True scientists do not mind others questioning and challenging their theories; they are eager to uncover the truth.

It is through the efforts of generations of scientists over the past few centuries, especially those from Europe and the United States, that science continues to progress, and what we do is merely an extension of their work. Although I did not engage in fundamental physics research after graduating from university, my love for science in my heart led me on this scientific research journey.

I do not allow myself to leave questions unanswered; I cannot stop thinking until all these questions are resolved. Over these years, I have indeed devoted a lot of time and energy, experiencing both joy and hardship. However, for my family, my wife has shouldered more burdens. She has always been supportive of my research work, and I am truly grateful to her.

As you read this book, you will slowly unravel the mysteries along with my thoughts. This requires patience and a genuine interest in and perseverance in science. At the end of the book, I express my gratitude to the academicians, professors, and scholars who have accompanied me on this research journey, especially Professor Richard. Only strong opponents can forge a strong self. Yes, he is my friend and the professor I respect most, but also my best opponent. I hope my work can inspire scholars and peers. Thank you!

Tony Yuan

December 13, 2024

Foreword

Tony Yuan has written an intriguing and technically detailed book that attempts to unite physics, more specifically gravity and light (electromagnetism). He comments and assesses crucial historical experiments conducted in the past and more recent ones on gravity and electromagnetic phenomena, in order to determine how they are related. The confirmation of gravitational waves has spurred this new look at the unification of physics. Following Newtonian Physics he discusses many astrophysical results, and introduces particles (xtons as he calls them) to explain the mechanism of gravity.

In my view, the solution to gravity indeed lies in particles in 3 D space, where Newtonian Mechanics holds sway and cannot and should not be replaced by geometrization (General Relativity) or indeterminacy (the dominant view of Quantum Mechanics). Rather, a mechanical universe holds sway whose foundation is the unit particle. Tony's xton, in my view, has similar features to microbits (that I have postulated with my colleague as the fundamental unit particle, in my co-authored book: Microbits: A New Unified Physics) and his view may be complementary to these concepts. Be it Tony's xtons or microbits, this approach yields a universe based on contact forces and primarily attraction and repulsion, (or tension etc.) by contact at the base level. There has to be such contact for causation. In other words, Tony's methodology is rational as it involves causation to the smallest levels in 3 D space and the amenability of applying deterministic mathematics to motion as did Newton. In other words Tony is trying to explain physics in a unified manner based on determinism and causality that overrides the causational and ontological irrationality of the Copenhagen version of Quantum Mechanics and General Relativity - though being polite about it – that are blocking unification. He is therefore hypothesizing or trying to create a theory on the steps of unifying it based on rationality and causation. Whether the xton causes gravitation (whose mechanism is very different than my 'microbits' concept of gravity) it is Tony's fundamental particle; it is theoretical. It is also mechanistic, but would need further study and experimental verification to prove. As such, both relativists and counter-relativists, indeterminists and realists need to seriously review his work to make progress toward an approach to the unification of physics that makes sense, as we move toward the 22nd century.

It is high time that science popularizers and physicists realized that ‘virtual’ particles, dark matter, string theory, dark energy, multiverses, and metaphors such as ‘the fabric of space-time’ and concoctions such as ‘curvature’, are the myths and the epicycles of modern times, and come back to real physics. Tony’s book is one of those that are coming toward this direction, standing on the shoulders of giants, as he states, but daring to look ahead boldly to advance the field and come closer to truth.

Canada

Philosopher of Science Nadeem Haque

August 24, 2024

Physics is in crisis. We must realize that Einstein’s relativity can provide some predictions of physical phenomena, but makes no sense physically. In SR, Einstein describes a moving frame of reference along the x-axis and assumes for a light beam emitted in the direction of the moving frame of reference the time interval x'/(c - v) and for a light beam that moves in the opposite direction the time interval x'/(c + v) interval, but let both time intervals happen in each moving direction of the light beam. Because the two different algebraic signs –v and +v can physically only result from different travelling directions of light beams, defining –v and +v for one travelling direction of a light beam makes physically no sense and is the mere result of Einstein’s physical arbitrariness. GR postulates that locally, at any place in the universe, we must measure the constant proper time t0, which is defined by the constant length of the light path divided by the constant speed of light, from which it follows that space-time is not curved locally by gravitation, but only viewed from a distance. It is absurd to imagine that we can observe space-time curvature from a distance, so that distant stars must move on a curved path of space-time around other stars, when at the position of the stars space-time is not curved locally. The sole purpose of Einstein's SR and GR is to mathematically enforce a constant speed of light in all reference frames, because the physical context is not understood as to why we measure a constant speed of light on Earth. Therefore, Einstein’s relativity is just an irrational belief in the constancy of the speed of light in all frames of reference, which has successfully taken

over universities and the public. Tony Yuan has written a profound book in which he presents new explanations beyond Einstein's relativity based on empirical research, with the aim of explaining gravitation and uniting gravitation with electromagnetism.

German natural philosopher, Reiner Georg Ziefle

November 12, 2024

When I first came across Tony's works online... (Being somewhat of teacher myself and needing to learn physics in double quick time...) I instantly recognised his uncomplicated learning style. I found his online papers: clear, concise and well presented. Drawing on comparisons with analogy after analogy in order to show a similarity in some respect. It was plain to see Tony Yuan needed no lessons in Delivery and Learning. And unlike Newton it was my guess that many attended his classes. His teaching methods certainly appealed to me and not the wall. Needless to say I stayed around and followed. A little over two years later and now I find myself writing the foreword to attend his book. Composed from those past online source papers. Volume opens with a mechanical drawing. I had to look twice, thought it was one of the Wright Brothers early flying craft or one of Leonardo da Vinci's sketches. Mechanically fine tuning mind in preparation of read. The power of symbolism. Undoubtedly an intriguing and precisely detailed compilation of known facts from the shoulders of giants. That we can reread not once but a thousand times over. Making for a valuable resource worthy of print. The idea of a correlation between light and gravity is certainly a challenging hypothesis. "The changing of bodies into light, and light into bodies, is very comfortable to the course of Nature, which seems delighted with transmutations." Projected by Newton (1642 - 1727) Newton, in fact, accomplishes the unification between terrestrial mechanics and celestial mechanics. Does such a mechanized unification between light and gravity exist. Is light a wave phenomenon, or does it consist of a flow of corpuscles? Or is there an inherent Yin and Yang duality. Well this is what Tony's book: Physical Mechanisms Behind Light and Gravity in the Universe attempts to lecture to and find out.

United Kingdom Alchemist Newton After Blake

November 15, 2024

All great ideas go through stages consisting of 1) dismiss, then, 2) made fun, then, 3) vehement and vicious attacks and finally 4) acceptance. your's will go through the same. we can only hope that the first 3 stages are short lasting. My support for your work will remain unwavering, G-D Willing, because I recognize its value and can foresee the immense changes it will bring about whether in my lifetime or later. I believe that there no person or people or nation is chosen for science. History has shown this quite clearly. it is the ego of people that has always impeded science but at the same time these very people have had to accept the inevitable. so, for now, your work is in the first stage and you will have to go through the two others before you are finally vindicated. so keep working and promoting your work. the world is a mess these days and people are just tired of politics, wars, economics, social upheavals and so on and very soon they will like to turn to something that is beautiful, fundamental and makes life interesting. this they will find in your work. this i am sure. so hang in there. the dawn is about to break and this night we have been in for such a long time is about to end.

United States B.Sc. (Physics). M.D. (Neurology) Mustafa Ali Khan

December 12, 2024

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The Voice of Scientists
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Chapter 1
Exploration of Light and Gravity

Humanity's exploration of science began with the study of light phenomena, as the mysterious nature of light sparked a quest for understanding the laws of nature. As early as ancient Greece, Aristotle observed the reflection of light on smooth surfaces and put forth the law that the angle of reflection equals the angle of incidence. In 1675, Newton proposed the existence of the ether in his "Hypothesis of Light" to explain the transmission of force between particles. Newton believed that light was composed of particles or corpuscles, and today's concepts of quantum mechanics, photons, and wave-particle duality have some similarities with Newton's understanding of light. Newton's particle theory of light was a widely accepted model of light propagation in the 17th and 18th centuries. However, later physicists tended to explain light using pure waves to account for common phenomena like interference patterns and diffraction. Snell's law of refraction revealed the relationship between the angles of incidence and refraction when light passes from one medium to another, supporting the wave theory of light. Thomas Young conducted the double-slit interference experiment with light, indicating that light was composed of waves, as the distribution of brightness could be explained by the interference of wavefronts alternately adding and subtracting. Young's experiment, carried out in the early 19th century, played a crucial role in understanding the wave theory of light and was considered to have refuted Isaac Newton's particle theory of light.

However, over time, the particle nature of light gradually emerged. By the late 19th century, the particle nature of light was further validated, as the discovery of the photoelectric effect indicated that light could behave like discrete particles under different circumstances. Einstein proposed a theoretical explanation for the particle nature of light. These seemingly contradictory findings necessitated a move beyond classical physics to consider the quantum nature of light. Light possesses both wave-like and particle-like properties. A series of double-slit interference experiments starting with Thomas Young vividly demonstrated the particle and wave characteristics of matter. Richard Feynman referred to these experiments as "a phenomenon which is impossible to explain in any classical way, and which has in it the heart of quantum mechanics. In fact, it contains the only mystery [of quantum mechanics]." In other words, quantum mechanics is full of unknowns, and research on why light exhibits wave-particle duality has never ceased.

The quest for the ether was a hot topic in the 19th century, as scientists conducted a series of experiments in search of the ether. Experiments like the Michelson-Morley experiment (MMX) and the Sagnac effect experiment, while failing to observe the ether wind, hinted at the existence of a completely dragged ether. Fizeau's experiment provided significant experimental evidence for the speed of light propagation in moving media, revealing the speed laws of light in moving media.

With Einstein's proposal of the Special Theory of Relativity (SR) in 1905, the fervor surrounding the ether began to dissipate, and scientists' attention shifted towards SR. However, voices questioning SR have never ceased since its inception. In the physics academic community, manuscripts that question and challenge SR are almost always rejected by SCI journals. Physics seems to have entered an unquestionable theological stage, and for humanity, which has only had a few hundred years of modern scientific civilization, how different is the current period from the medieval "geocentric theory" era?

Unlike the apparent visibility of light phenomena, gravity is invisible, yet it can be constantly perceived by us. Newton proposed the law of universal gravitation, stating that there is a gravitational force between any two objects, the magnitude of which is directly proportional to their masses and inversely proportional to the square of the distance between them. Energy is transmitted through the gravitational field, which acts as an instantaneous force, meaning that the energy transmission speed in the gravitational field is extremely high. Newton's theory of gravity successfully explained the motion of celestial bodies. Regarding the speed of the gravitational field, Laplace and Newton held similar views. Laplace calculated the speed of energy transmission in the gravitational field to be 7 million times the speed of light, based on the expansion rate of the moon's orbit. Although the speed of light appears significantly slow relative to the gravitational field, the speed of gravitational waves is consistent with the speed of light. This seems to suggest that gravitational waves and light share the same mode of energy transmission, which is distinct from the gravitational field. In the early 20th century, Einstein proposed the General Theory of Relativity (GR), which differs from Newton's explanation of gravity, with the major distinction lying in the view of gravitational speed. GR asserts that the speed of gravity equals the speed of light. However, the EIH equation based on GR implicitly assumes that the speed of gravity is much greater than the speed of light, leading to a significant contradiction. Celestial bodies in the universe move at speeds that cannot be ignored, and GR should take into account the delay in gravity caused by slow gravitational speeds. For instance, the diameter of the Milky Way reaches 180,000 light-years, and the

gravitational force from the center of the Milky Way would take 90,000 years to reach its edge, which would destabilize the galaxy, altering its appearance from what we see today. Computer simulations have also confirmed that if the speed of gravity equals the speed of light, the orbits of celestial bodies in the solar system would be unstable. Another significant difference lies in the description of space, with Newton positing flat space, an argument also supported by Chinese physicist Lee TiPei. However, GR suggests that mass can bend space. This raises an intriguing question: which side around the Earth is space curved towards? Is it above, below, to the left, or to the right of the Earth? GR faces many challenges. While GR claims to precisely explain various experimental phenomena and astronomical observations, in reality, these explanations seem more like "the will of God."

In 2005, Robert B. Laughlin (Physics Nobel Laureate, Stanford University), wrote about the nature of space: "It is ironic that Einstein's most creative work, the general theory of relativity, should boil down to conceptualizing space as a medium when his original premise [in special relativity] was that no such medium existed ... The word 'ether' has extremely negative connotations in theoretical physics because of its past association with opposition to relativity. This is unfortunate because, stripped of these connotations, it rather nicely captures the way most physicists actually think about the vacuum. ... Relativity actually says nothing about the existence or nonexistence of matter pervading the universe, only that any such matter must have relativistic symmetry." Such statements are bold and dangerous in the current physics environment. We cannot say that most of Einstein's supporters are mere crowd-pleasers, blind worshipers, or have ulterior motives, but such individuals are not uncommon, making genuine scientific exploration for truth difficult.

We have excerpted some texts about Einstein:

"I have studied the problem of gravitational waves... I admit to you that general relativity is closer to the ether hypothesis than special relativity... This "g_{uv}" state of the ether... is a function that depends on the position of material processes." - "To Lorentz" (June 17, 1916)

"According to general relativity, space has been endowed with physical properties... A space without ether is inconceivable: light cannot propagate, and standards of space and time cannot exist, so there is no physical meaning to spacetime intervals." - "On the General Theory of Relativity" (1920)

"Einstein is a guy who only cares about his own convenience, overturning what he said the previous year every year."
To Pal Fhrenfest, December 1915.

"My series of papers on gravity is a chain of errors." - "To Lorentz" (January 1916)

Humanity has never ceased to explore light and gravity. Current physics is shrouded in mist. We need to avoid blind worship and also avoid arbitrary denial. We need to reveal the truth. Physics must follow the path of science and avoid developing into theology. I have taken on this work out of love and perseverance.

To truly understand the physics behind light and gravity in the universe, we must delve deeply into the microphysics of light and gravity, not only through experimental observation of their behaviors but also through an understanding of the microscopic mechanics of energy transfer. Therefore, we must unravel the details of the microstructures and energy transfer behaviors of electric fields, magnetic fields, and gravitational fields, as well as their interrelationships. We shall revisit the experiments conducted by the great physicists of the 19th century to seek the answers we need. Let us begin with light.

Chapter 2
Searching for the Ether

The study of light is inseparable from experiments. Experiments can reveal the behavioral characteristics of light and verify the accuracy of optical theories. Among numerous optical experiments, the Michelson-Morley experiment (MMX) stands out as a prominent endeavor in the search for the ether, and we will reexamine the MMX.[4]

2.1 Michelson-Morley Experiment

The physical theories of the 19th century hypothesized that, just as surface water waves require a supporting medium (i.e., a "medium") to propagate, sound also requires a medium to transmit its wave motion (such as air or water). Therefore, it was believed that light must also require a medium, known as the "luminiferous ether," to transmit its waves. Since light can travel through a vacuum, it was thought that even empty space must be filled with ether. Due to the immense speed of light and the absence of apparent friction or resistance when passing through the ether, it was believed to possess an extraordinarily unique combination of properties. Designing experiments to investigate these properties became a primary task of 19th-century physics, and the Michelson-Morley experiment (MMX) is one of the most famous experiments in this regard. It was conducted in 1887 by American physicists Albert Michelson and Edward Morley with the aim of exploring the existence of the ether and the manner in which light propagates, as shown in Figure 2.1.

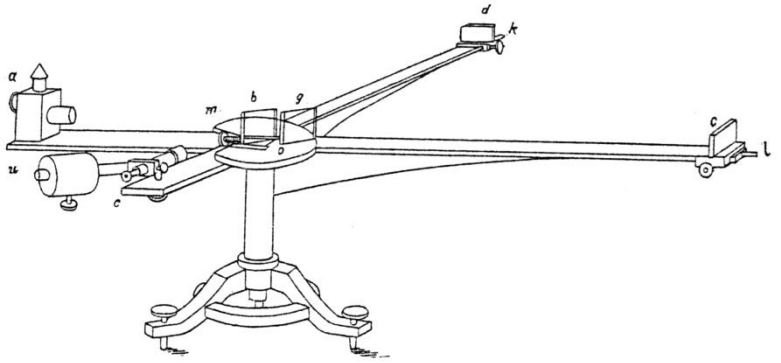


Figure 2.1: Michelson-Morley Experiment

At that time, scientists widely believed in the existence of the ether medium in the universe through which light propagated. The experiment involved splitting and

recombining a beam of light along two perpendicular paths, observing interference phenomena. However, the experimental results showed that the speed of light was unaffected by the Earth's motion, meaning that on the Earth's surface, the speed of light remained constant and was not influenced by either the Earth's motion or the ether. Scientists provided various explanations for this result.

2.2 Classic Analysis of the MMX

According to the ether theory, light would combine with the velocity of the ether. Therefore, as long as the Earth's velocity and the velocity of the ether were not consistent, light emitted in different directions on Earth, after traveling the same distance, would take different amounts of time to reflect back to the starting point. This is illustrated in Figure 2.2.

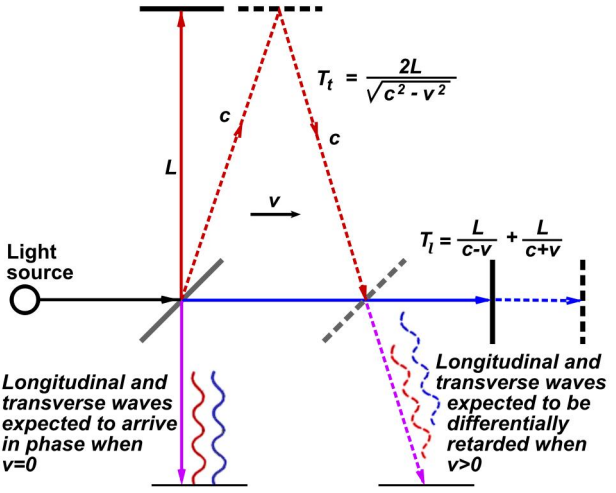

$T_t = \frac{2L}{\sqrt{c^2 - v^2}}$
c
c
L
v
$T_l = \frac{L}{c-v} + \frac{L}{c+v}$
Light source
Longitudinal and transverse waves expected to arrive in phase when v=0
Longitudinal and transverse waves expected to be differentially retarded when v>0

Figure 2.2: Mathematical Computational Model of the MMX

The propagation time of the light beam in the longitudinal direction can be derived as follows: The light is emitted from the light source and propagates through the ether at the speed of light, c. At T=0, it passes through the half-silvered mirror located at the origin. At this time, the reflecting mirror is positioned at a distance of L (the length of the interferometer arms) and moving at a velocity of v. The light beam strikes the reflecting mirror at time T1, traveling a distance of cT1. By this time, the mirror has moved a distance of vT1. Therefore, cT1 = L + vT1, which gives the travel time T1 = L/(c-v). The same consideration applies to the backward journey, with the opposite sign for v, resulting in cT2 = L - vT2, giving T2 = L/(c+v). The total travel time, TL, is the sum of T1 and T2, which can be expressed as:

$$T_l = \frac{L}{c-v} + \frac{L}{c+v} = \frac{2L}{c}\frac{1}{1-\frac{v^2}{c^2}} \approx \frac{2L}{c}\left(1+\frac{v^2}{c^2}\right), \tag{2.1}$$

Michelson correctly derived this expression in 1881; however, he obtained an incorrect expression for the transverse direction.

$$T_t = 2L/c \tag{2.2}$$

Because he neglected the increase in path length in the stationary frame of the ether. Alfred Potier (1882) and Hendrik Lorentz (1886) corrected this oversight. The derivation for the transverse direction can be given as follows: The light beam propagates at the speed of light, c, and strikes the mirror at time T3, traveling a distance of cT. Meanwhile, the mirror has moved a distance of vT3 in the x-direction. Therefore, in order to hit the mirror, the path traveled by the light beam is L in the y-direction (assuming equal arm lengths) and vT3 in the x-direction. This forms an inclined path, and thus the actual traveled distance by the light beam is given by:

$$\sqrt{L^2 + (vT3)^2} \tag{2.3}$$

Therefore

$$cT3 = \sqrt{L^2 + (vT3)^2} \tag{2.4}$$

Therefore, the travel time

$$T3 = L/\sqrt{c^2 - v^2} \tag{2.5}$$

This is the same for the backward journey. The total travel time, Tt, is equal to 2T, resulting in:

$$T_t = \frac{2L}{\sqrt{c^2-v^2}} = \frac{2L}{c}\frac{1}{\sqrt{1-\frac{v^2}{c^2}}} \approx \frac{2L}{c}\left(1+\frac{v^2}{2c^2}\right) \tag{2.6}$$

Calculating the time difference in light travel

$$T_l - T_t = \frac{2L}{c}\left(\frac{1}{1-\frac{v^2}{c^2}} - \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}\right) \tag{2.7}$$

To find the path difference, simply multiply it by c.

$$\Delta\lambda_1 = 2L\left(\frac{1}{1-\frac{v^2}{c^2}} - \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}\right) \tag{2.8}$$

If the relation $v^2/c^2 \ll 1$ holds, then the expression can be simplified using a first-order binomial expansion.

$$(1-x)^n = 1-nx \tag{2.9}$$

Therefore, rewriting the above content:

$$\Delta\lambda_1 = 2L\left(\left(1-\frac{v^2}{c^2}\right)^{-1} - \left(1-\frac{v^2}{c^2}\right)^{-1/2}\right), \tag{2.10}$$

According to (2.9),

$$\Delta\lambda_1 = 2L\left(\left(1+\frac{v^2}{c^2}\right) - \left(1+\frac{v^2}{2c^2}\right)\right) = 2L\,\frac{v^2}{2c^2} = L\,\frac{v^2}{c^2} \tag{2.11}$$

In order to demonstrate the existence of the ether, Michelson and Morley attempted to find the "fringe shift." The idea was straightforward: when rotated by 90 degrees, the interference pattern's fringes should undergo a displacement since the roles of the two light beams would be exchanged. To find the fringe shift, denoted as "n," the path difference in the first direction needs to be subtracted from the path difference in the second direction, and then divided by the wavelength of light:

$$n = \frac{\Delta\lambda_1 - \Delta\lambda_2}{\lambda} \approx \frac{2Lv^2}{\lambda c^2} \tag{2.12}$$

Due to L being approximately 11 meters and λ being approximately 500 nanometers, the expected fringe shift, denoted as "n," is estimated to be around 0.44. The negative results led Michelson to conclude that there was no measurable ether drift. However, he never fully accepted this on a personal level, and the negative results troubled him for the rest of his life.

The experimental results showed that the speed of light was unaffected by the Earth's motion, meaning that on the Earth's surface, the speed of light remained constant and was

not influenced by either the Earth's motion or the ether. The MMX experiment has been repeated multiple times, with increasing sensitivity. This includes experiments conducted from 1902 to 1905 and a series of experiments in the 1920s. Most recently, in 2009, optical resonator experiments confirmed the absence of any ether wind at the level of 10^{-17}. The results of the MMX experiment demonstrated that the "ether wind" does not exist, negating theories of an absolutely stationary ether or a partially dragged ether. Only a scenario where the ether is completely dragged by the Earth can reasonably explain the MMX results, but this viewpoint encounters difficulties in explaining stellar aberration phenomena.

2.3 Ether Completely Dragged Explanation of MMX

Although the Michelson-Morley experiment did not yield the expected results, it does not prove the absence of ether around the Earth. It is similar to the absence of wind, but you cannot say it is because there is no air. When the ether around the Earth is completely dragged by the Earth, with the Earth as a reference frame, the speed of light in all directions would be equal. Therefore, there would be no perception of an ether wind and no observable fringe shift as expected. It appears that MMX provides strong evidence for Stokes' hypothesis of complete ether dragging [5]. Initially, Michelson also believed that his experiment would confirm Stokes' theory. However, the contradiction between complete ether drag and the observed stellar aberration undermined the acceptance of the theory of complete ether drag at that time.

Nevertheless, we must confront the fact that the hypothesis of complete ether drag can provide a perfect explanation for MMX. Therefore, let us consider the possibility that there might have been issues with the scientific explanation of stellar aberration at that time. This drives us to reexamine the phenomenon of stellar aberration.

Chapter 3
Stellar Aberration

The Hypothesis of Complete Ether Drag encounters difficulties in explaining stellar aberration, so it is necessary to understand what stellar aberration (astronomical aberration) is. In astronomy, aberration refers to the apparent visual displacement of celestial objects due to the variation in the observer's velocity. This phenomenon is primarily caused by the periodic changes in the Earth's orbital speed, resulting in periodic variations in the observed positions of stars over the course of a year. To delve deeper into this phenomenon, we need to examine whether there are changes in the path of light as it enters Earth from space and identify the factors that influence the path of light. This will help us uncover the underlying physical mechanisms behind the phenomenon of stellar aberration.

3.1 Explanation of Aberration with Tilted Raindrops

Aberration can be explained as the difference in the angle of a light beam in different inertial reference frames. A common analogy is to consider the apparent direction of rain. In the reference frame of a stationary person, if the rain falls vertically, the umbrella can block the rain without tilting, as shown in Figure 3.1.

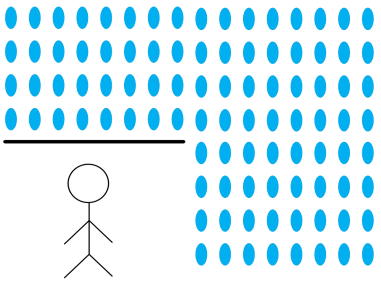


Figure 3.1: Rain falling vertically in the reference frame of a stationary person

So, for an observer moving forward with a velocity v, the rain will arrive at an angle, and the moving observer needs to tilt their umbrella forward. The faster the observer moves, the greater the tilt required. If the umbrella is not tilted, the observer will be soaked by the rain, as shown in Figure 3.2.

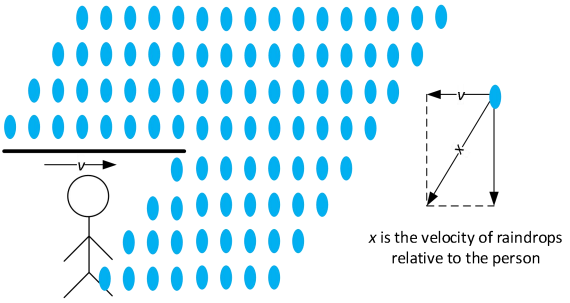


Figure 3.2: Rain falling at an angle in the reference frame of a moving person.

Can light be seen as falling raindrops? In this analogy, the ultimate effect is that light rays, when illuminated from the side in the stationary frame, will appear tilted forward in the frame of the moving observer. See Figure 3.3.

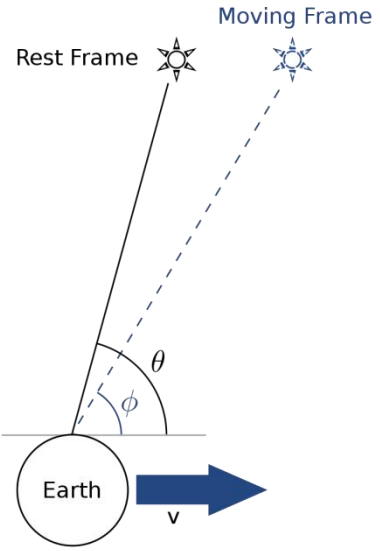


Figure 3.3: Apparent position (ϕ) and true position (θ) of a star as observed from Earth.

Due to the changing direction of Earth's motion along its orbit, this tilt direction will vary throughout the year, resulting in the apparent position of a star being different from its true position measured in the Sun's inertial frame.

It appears that treating light as raindrops can provide a good explanation for the phenomenon of aberration. However, we must note an important distinction between

them. Raindrops acquire the velocity of Earth, while light does not acquire Earth's velocity upon emission. If light were not influenced by Earth, it would propagate in a straight line at all times, and the relationship between light and the observer could be likened to that of raindrops and the observer. Only light does not add the speed of Earth, while raindrops do add the speed of Earth.

If light were not affected by Earth, this explanation would seem to be correct.

3.2 Classic Explanation in Earth's Reference Frame

As shown in Figure 3.3, when observing stars using astronomical telescopes, there is a discrepancy between the apparent position (ϕ) and the true position (θ) of the star. Therefore, the astronomical telescope needs to be adjusted by an angle (θ - ϕ) to observe the star accurately.

According to classical analysis, in the reference frame of the Sun, the speed of light is c, and the velocity components of light in the x and y directions are u_x and u_y , respectively. Thus, we have:

$$\tan(\theta) = u_y / u_x , \tag{3.1}$$

Assuming that the Earth is moving with a velocity v in the x-direction, by adding velocities, in the Earth's reference frame, the x-component of the speed of light becomes $u_x + v$, while the y-component remains unchanged as $u_y^{'} = u_y$. Therefore, in the Earth's reference frame,

$$\tan(\phi) = u_y^{'} / u_x^{'} = u_y / (u_y + v) = c * \sin(\theta) / (v + c * \cos(\theta)) = \frac{\sin(\theta)}{v / c + \cos(\theta)} \tag{3.2}$$

When θ is 90°, equation (3.2) yields the maximum value, $\tan(\theta - \phi) = v / c$, in the limit where v/c << 1, it can be approximated as:

$$\theta - \phi = v / c \tag{3.3}$$

The motion of the Earth results in the parallax effect observed in the positions of stars. As the Earth revolves around the Sun, its motion causes a slight displacement of the starlight at the observation point on Earth, which varies periodically. When θ is 90°, the maximum displacement can be obtained. Equation (3.3) reveals that the maximum angle adjustment required by an astronomical telescope when observing a star is determined by the Earth's velocity v and the speed of light in the air, c.

This classic explanation, based on the Earth's reference frame, is similar to the explanation of aberration using the analogy of tilted raindrops.

3.3 Bradley's Classic Explanation in the Sun's Reference Frame

Bradley proposed a new explanation based on the particle theory of light, where light is composed of particles. In his classic explanation, Bradley considered the motion of Earth relative to a beam of light particles moving at a finite speed. His explanation developed in the reference frame of the Sun, which is different from the previous Earth-based explanation, but fundamentally they are the same.

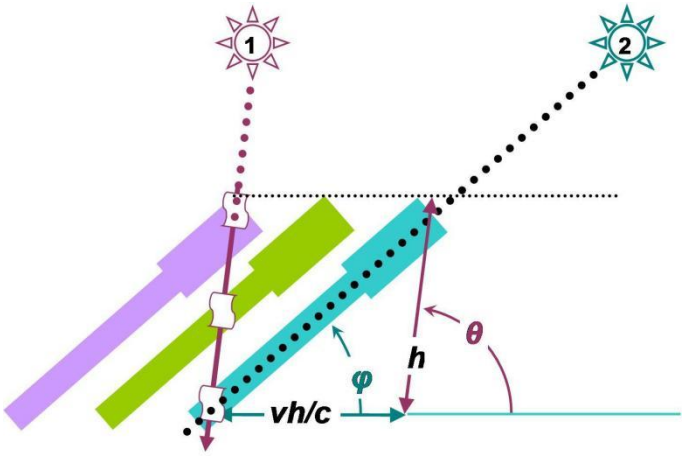


Figure 3.4: Model of Observing Stars with an Astronomical Telescope

As shown in Figure 3.4, a distant star is considered stationary relative to the Sun, and the star is located at a significant distance, making parallax negligible. In the Sun's stationary reference frame, this means that the light from the star propagates to the Earth observer in parallel paths, arriving at the same angle regardless of the Earth's position on its orbit.

Suppose we observe this star from Earth using a telescope, idealized as a narrow tube. The light enters the tube at an angle θ from the star, and it takes a time of h/c for the light to reach the bottom of the tube. Assuming the observation is conducted from Earth, which is moving at a certain velocity v, during the time it takes for the light to travel from the tube's entrance to the bottom, the tube has moved a distance of vh/c. Therefore, to ensure that the light particle reaches the bottom of the tube, the tube must be tilted at an angle ϕ, which is different from θ. As the Earth moves along its orbit, it changes direction, causing the angle ϕ to vary with the time of observation throughout the year. The angular displacement ϕ and the true angle θ are related by trigonometric relationships as follows:

$$\tan(\phi) = \frac{h\sin(\theta)}{hv/c + h\cos(\theta)} = \frac{\sin(\theta)}{v/c + \cos(\theta)}, \tag{3.4}$$

It can be observed that Bradley, through a different derivation, arrived at the same conclusion as equation (3.2). This is not a coincidence; fundamentally, they are both based on classical physics explanations, with the only difference being the choice of reference frame.

3.4 Thomas Young's Classical Explanation Based on the Ether

Later, Thomas Young adapted Bradley's explanation of particle-like light to wave-like light propagated through a medium called the luminiferous ether. His reasoning was similar to Bradley's. He believed that this medium was stationary in the reference frame of the Sun and passed through the Earth unaffected. Otherwise, the medium (as well as light) would move along with the Earth's motion, resulting in the inability to observe aberration. Refer to Figure 3.5. [7]

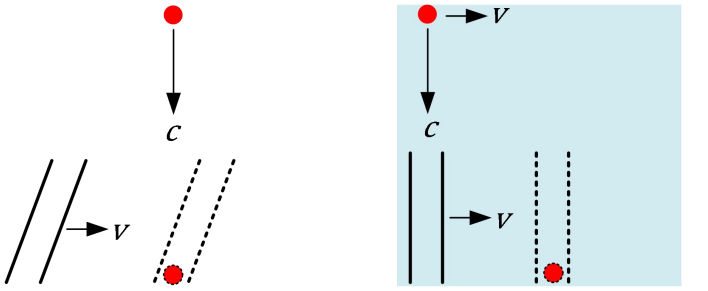


Figure 3.5: Comparison of Telescope Angles with the Medium Unaffected by Earth and the Medium Dragged by Earth

However, it was soon discovered that this theory could not explain the aberration observed in the presence of materials with a non-vacuum refractive index. An important example is a telescope filled with water. In such a telescope, the speed of light is c/n, where c is the speed of light in vacuum and n is the refractive index. Therefore, based on Bradley's and Young's reasoning, the angle of aberration is given by the following equation.

$$\tan(\phi) = \frac{\sin(\theta)}{v/(c/n) + \cos(\theta)}, \tag{3.5}$$

It predicts the medium-related angle of aberration. When considering refraction at the objective of the telescope, this result deviates even more from the vacuum result. In 1810, François Arago conducted a similar experiment and found that the aberration was unaffected by the medium inside the telescope, providing conclusive evidence against Young's theory. This experiment was subsequently verified by many others in the following decades, with the most accurate result obtained by Airy in 1871, which yielded the same outcome.[8]

Clearly, the experiments conducted by Airy and others directly contradicted the explanations provided by Bradley and Young. Equation (3.5) did not reveal the true underlying physical mechanism behind stellar aberration. So, is it possible for light to acquire additional velocity due to the influence of the medium in the telescope, allowing photons to reach the bottom of the tube? The Fizeau experiment provides us with the answer.

The Fizeau experiment, conducted by Hippolyte Fizeau in 1851, measured the relative velocity of light in moving water. He determined that the speed of light along the direction of the water flow is given by: [2]

$$w_{+} = c/n + v(1-1/n^2)\,, \tag{3.6}$$

The light appears to be dragged by the water. Therefore, in the telescope, the dragging effect of the medium on light causes it to acquire an additional velocity in the horizontal direction. Due to this increased velocity effect, if the angle of the telescope remains unchanged, photons will find it even more difficult to reach the bottom of the tube. Thus, the increased velocity in the horizontal direction caused by the movement of the medium in the telescope does not counteract the downward displacement of the light beam.

Therefore, the classical explanations provided by Bradley and Thomas Young for stellar aberration are both incorrect. In other words, stellar aberration does not invalidate the hypothesis of "complete ether drag."

3.5 Explanation of Relativity Independent of Reference Frames

Relativity employs the relativistic velocity addition formula, which can be derived from the Lorentz transformations between different reference frames.

$$u_x^{'} = (u_x + v)/(1 + u_x v/c^2)\,, \tag{3.7}$$

$$u_y^{'} = u_y/\gamma(1 + u_x v/c^2)\,, \tag{3.8}$$

In this case, $\gamma = 1/\sqrt{1-v^2/c^2}$, the components of the light beam in the Earth frame are determined based on the components in the Sun frame. Therefore, the angle of the light beam in the Earth frame is given by.

$$\tan(\phi) = \frac{u_y^{'}}{u_x^{'}} = \frac{u_y}{\gamma(u_x + v)} = \frac{\sin(\theta)}{\gamma(v/c + \cos(\theta))}\,, \tag{3.9}$$

if θ = 90°, we obtain:

$$\sin(\theta - \phi) = v/c\,, \tag{3.10}$$

in the limit where v/c << 1, it can be approximated as:

$$\theta - \phi = v / c \,, \tag{3.11}$$

We can see that the final result obtained is consistent with the classical derivation. However, the relativistic derivation maintains the constant speed of light c in all reference frames. On the other hand, Bradley's and Young's explanations require the assumption of adding the Earth's velocity based on the speed of light in the Sun's reference frame. But like the classical explanation, Equation (3.9) still does not match the results of the Airy experiment.

It appears that the Airy experiment poses a barrier that cannot be overcome by both classical physics and special relativity. We must find a correct explanation for the Airy experiment because it involves two crucial experiments in optics, the Michelson-Morley experiment (MMX) and stellar aberration.

3.6 Analysis of the Airy Experiment

The key to explaining the Airy experiment lies in addressing the fact that, regardless of the speed of photons in the medium, the angle of the telescope remains unchanged, and the photons cannot reach the bottom of the tube. Now, let's suppose that on Earth, there is a small ball, as shown in Figure 3.6, which is unaffected by gravity and air resistance. If we make this ball move towards the target direction, I believe no one would question the following fact: Regardless of the ball's velocity, it will hit the target.

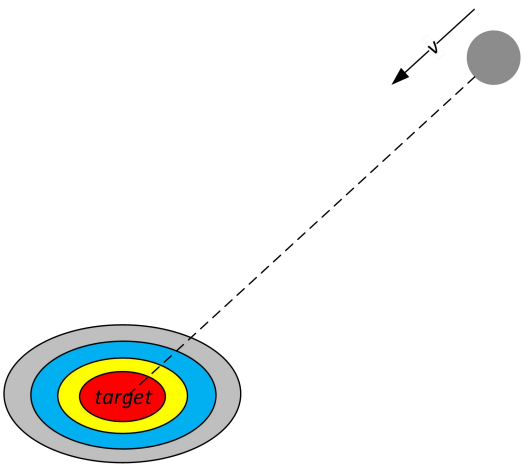


Figure 3.6: Physical model of a ball hitting a target unaffected by gravity and resistance.

This is because the ball has added the Earth's velocity, so regardless of whether the ball is

fast or slow, it does not affect the ball's final arrival at the target position. Therefore, we can imagine a scenario where photons add the Earth's velocity, so regardless of the speed of photons in the medium, it does not affect the photons hitting the bottom of the telescope. This requires that the light has already added the Earth's velocity before entering the top of the telescope, and the telescope has aligned itself with the direction of light. Is such a possibility possible?

We can provide analysis based on general relativity. As shown in Figure 3.7, according to Einstein's general theory of relativity, the mass of the Earth bends the surrounding spacetime, creating a gravitational field. The gravitational field affects the trajectory of objects and light, causing light to propagate along curved spacetime. According to the general theory of relativity, the curved spacetime moves with the movement of Earth's mass, and light propagates along the curved spacetime, effectively being "dragged" by the curved spacetime at the same speed as Earth's movement. In other words, light is "dragged" by the gravitational field of the Earth. After entering the gravitational field of the Earth, the influence of the gravitational field on the speed of light gradually increases, and light gradually accumulates the velocity of the Earth. When light starts to move away from the Earth, the influence of the gravitational field on the speed of light gradually weakens, and light gradually loses the velocity of the Earth. It is similar to light entering water, where the speed of light slows down, and when light leaves the water, its speed returns to normal.

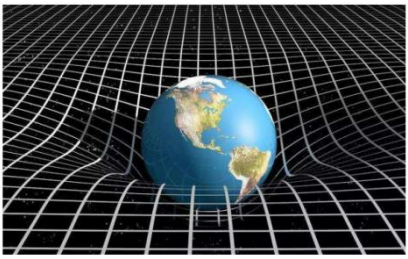


Figure 3.7: According to the general theory of relativity, the spacetime around the Earth is curved by the mass of the Earth.

We can also provide analysis based on the distribution characteristics of the gravitational field. We know that the gravitational field distribution around the Earth is not uniform. According to the universal law of gravitation, $G = G0Mm/R^2$, the gravitational field becomes weaker as the distance increases and stronger as the distance decreases. In an uneven gravitational field, the speed of light varies slightly, and light undergoes refraction.

Due to the weaker gravitational field in the distance and the stronger gravitational field nearby, when light approaches the Earth, the refracted angle will be smaller than the incident angle, causing light to bend towards the center of the Earth, as shown in Figure 3.8. Similarly (since the light path is reversible), when light moves away from the Earth, the refracted angle will be greater than the incident angle, and light will still bend towards the center of the Earth.

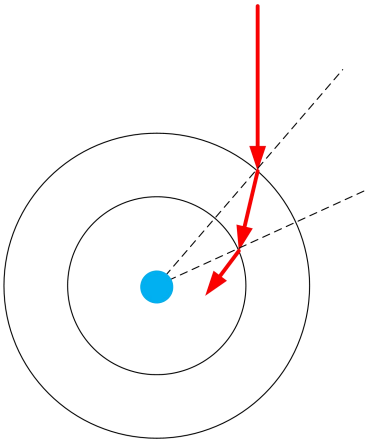


Figure 3.8: Light bending towards the gravitational source in an uneven gravitational field.

In this way, the light from a distant star, under the influence of the Earth's gravitational field, adds the velocity of the Earth and bends due to the non-uniformity of the Earth's gravitational field. With this physical mechanism, the Airy experiment can be reasonably explained. This physical mechanism can also provide a good explanation for the Michelson-Morley experiment. Therefore, the Airy experiment can be considered a crucial key in testing the correctness of optical theories.

At that time, it was hasty to dismiss the complete ether dragging hypothesis solely based on stellar aberration. If it had been realized that the "ether density" or "tension between ethers" around the Earth might be non-uniform, with a distribution consistent with the gravitational field, and that light would undergo refraction in the non-uniform ether resistance, then the fate of the complete ether dragging theory might have been different.

3.7 Summary of MMX and Stellar Aberration

Perhaps the propagation of light does not require a medium; we only need the premise that on the surface of the Earth, light is completely "dragged" by the gravitational field. This can provide a good explanation for the Michelson-Morley experiment. However, it is

also possible that there exists a medium-like ether composed of particles that are "captured" by the gravitational field of the Earth, resulting in a non-uniform distribution of ether resistance similar to the gravitational field, and moving with the Earth, light would need to propagate through these particles. The wave-particle duality of light also suggests the possible existence of such medium particles. This particle would also become the cornerstone of a unified field theory within the same physical model.

Scientists such as Bradley, Young, Einstein, and others have been studying stellar aberration for several centuries. Their explanations and experiments regarding the aberration phenomenon have gradually revealed the underlying physical mechanisms of light propagation. In particular, the Airy experiment has become a touchstone for testing various explanations. Light can be "dragged" by the gravitational field and undergo refraction due to the non-uniform gravitational field. Therefore, in such a physical mechanism, the speed of light in a medium does not affect the results of the Airy experiment, and it can also provide a good explanation for the Michelson-Morley experiment. A proper understanding of the Michelson-Morley experiment and stellar aberration is of significant importance in studying light. This is why we have dedicated a considerable amount of discussion to analyzing the Michelson-Morley experiment and stellar aberration. For the study of light, the Michelson-Morley experiment and stellar aberration are just the starting point. We need to analyze more experiments to uncover further details about light.

3.8 Explanation of MMX by Special Theory of Relativity

Einstein made a bold interpretation of the Michelson-Morley experiment by assuming the principle of the constancy of the speed of light, which states that the speed of light is constant in any inertial reference frame. Based on the Lorentz transformations, he derived the Special Theory of Relativity. The constancy of the speed of light became the theoretical foundation of the Special Theory of Relativity, and the Michelson-Morley experiment became the experimental basis for it. From this perspective, Einstein merely used an "assumption" to explain the Michelson-Morley experiment. Therefore, apart from being "bold," this assumption did not provide any substantial explanation for the Michelson-Morley experiment. This is also a significant reason why the Special Theory of Relativity faced widespread questioning after its proposal.

However, there is a thought-provoking question: Is the Special Theory of Relativity, which is based on the "bold assumption," correct? We cannot avoid falling into the abyss of

questioning the Special Theory of Relativity. Therefore, let us bring clarity to this issue by understanding the mathematical logic and physical mechanisms behind the Lorentz transformations and the Special Theory of Relativity.

Chapter 4
Mathematical Logic and Physical Mechanisms Behind the Lorentz Transformations and Special Relativity

In different inertial reference frames, people have different perceptions of time and distance. When it is necessary to convert the spacetime coordinates between two inertial reference frames, subtle changes occur in the coordinates of time and space. These changes are precisely described by the equations of the Lorentz transformations. The Lorentz transformations hold a significant position in physics, and the coordinate transformation equations of the Special Theory of Relativity reveal the relativity and unity of spacetime. However, we must also note that there are evident differences in mathematical forms between the Lorentz transformations and the Special Theory of Relativity.

In the following discussion, we will provide a detailed explanation of the Lorentz transformations and the Special Theory of Relativity, delving into their differences and commonalities. We aim to uncover the mathematical logic and physical mechanisms behind the Lorentz transformations and the Special Theory of Relativity.

4.1 Ether Background of the Lorentz Transformations

In the 19th century, scientists widely believed in the existence of a substance called the luminiferous ether, which was thought to permeate the universe. It was believed that light propagated through this medium, as depicted in Figure 4.1.

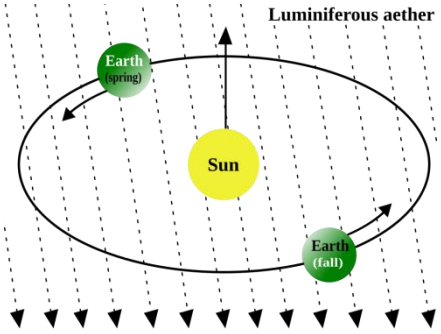


Figure 4.1: Luminiferous Ether: Some hypothesized that the Earth moves through a luminiferous ether "medium" that carries light.

The MMX (Michelson-Morley Experiment) was also conducted with the aim of searching for the ether. The results of the MMX experiment showed that the speed of light is independent of the Earth's motion. In other words, on the Earth's surface, the speed of light is constant and unaffected by the Earth's motion or the ether. This result made the MMX experiment a hot topic in scientific research at the time.

In explaining the Michelson-Morley experiment, Lorentz introduced the concept of ether contraction to explain the constancy of the speed of light. He proposed that even if the ether existed, it would not affect the measurement of the speed of light because of a "Fitzgerald-Lorentz contraction[9]." According to this idea, as the ether acted as a medium for the propagation of light, the speed of light would be slower along the direction of the ether wind. This was attributed to the motion of the ether, which influenced the intermolecular forces within the instruments, causing a reduction in the distance between molecules, i.e., a compression of the ether. This compression resulted in a shorter path for light traveling along the direction of the ether wind, allowing it to arrive at the observation point simultaneously with light traveling perpendicular to the ether wind.

In simpler terms, if you want to measure a compressed distance, you would need a ruler. However, the ruler itself would also be compressed, and the time coordinate would need to be modified ("local time"). Therefore, this compression effect cannot be measured directly. Lorentz's explanation reconciled the constancy of the speed of light with the existence of the ether by attributing it to ether compression. It provided a new perspective for the physics community at that time.

However, it is worth noting that the existence of the ether has not been directly observed, and the hypothesis of ether contraction also faces some theoretical difficulties. Nonetheless, the Lorentz transformations provided the fundamental relations for the transformation of physical events in spacetime between different inertial frames, exerting a profound influence on the development of modern physics. Although Lorentz humbly described it as a mathematical trick, it had far-reaching implications.

4.2 Derivation of the Lorentz Transformations

Lorentz attempted to explain the constancy of the speed of light through ether compression, which was a classical physics perspective. Although the idea of ether compression has been abandoned, it is known that in two different inertial reference frames, S and S', people have different perceptions of time and distance. Therefore, even

without the existence of the ether, we can make different measurements of physical events in each inertial reference frame. [10]The Lorentz transformations are a type of spacetime coordinate transformation based on the assumption of the constancy of the speed of light in any inertial reference frame and are mathematically rigorous. In the following derivation, we will focus on S and S' to derive the equations of the Lorentz transformations.

As shown in Figure 4.2, let's consider two inertial coordinate systems, S and S'. The origin O' of the S' frame moves with a velocity v along the positive X-axis relative to the origin O of the S frame. The spacetime coordinates of an arbitrary event in the S frame and the S' frame are represented as (x, y, z, t) and (x', y', z', t'), respectively. Here, t and t' denote the respective times in the S frame and the S' frame. The speed of light measured in both S and S' is constant and denoted as c. Now, let's consider a beam of light emitted from the coincident origins O (O') and traveling along the positive x-axis. The coordinates of the wavefront when it reaches point P are denoted as (X, Y, Z, T) and (X', Y', Z', T') in the S and S' frames, respectively.

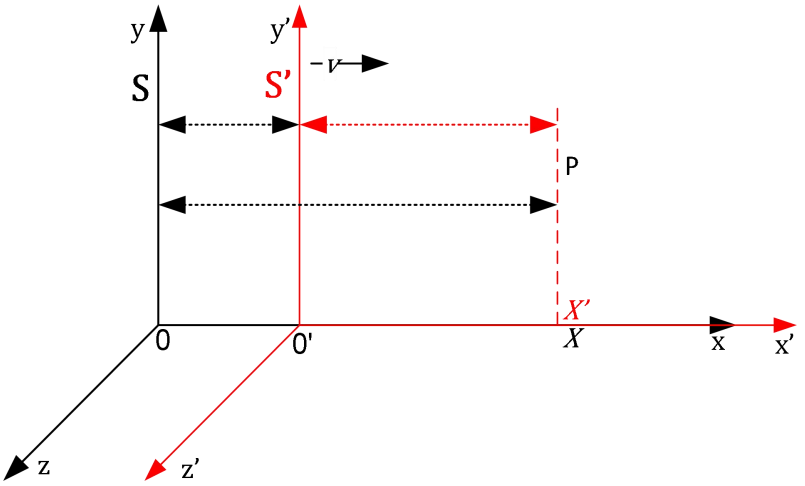


Figure 4.2: Inertial Reference Frame Model in the Lorentz Transformations

When the two inertial coordinate systems coincide, the coordinate origins are set as (x = x' = 0), and the timing starts. As the light reaches point P, the elapsed time in the S' frame is T', and the distance that S' has moved forward is vT'. Therefore, we have:

$$OX = vT' + X', \tag{4.1}$$

In the S frame, the elapsed time is T, and the distance that S' has moved forward is vT.

Therefore, we have:

$$O'X' = X - vT \tag{4.2}$$

We conjecture the existence of a γ (which could be a constant or a function) that mathematically allows the following equation to hold:

$$X = \gamma(X' + vT'), \tag{4.3}$$

$$X' = \gamma(X - vT), \tag{4.4}$$

There is no relative velocity between y and y', and z and z'. Their coordinates remain the same. Therefore, we only need to analyze the x-axis. By substituting equation (4.2) into equation (4.1), we can solve for T':

$$T' = \gamma T + (1 - \gamma^2)X / \gamma v, \tag{4.5}$$

Since the measured speed of light is constant and equal to c in both S and S', we have:

$$X = cT, \tag{4.6}$$

$$X' = cT', \tag{4.7}$$

By multiplying equations (4.3) and (4.4), we obtain:

$$XX' = \gamma^2(XX' - X'vT + XvT' - v^2TT'), \tag{4.8}$$

By substituting equations (4.6) and (4.7) into equation (4.8), we obtain:

$$cTcT' = \gamma^2(cTcT' - cT'vT + cTvT' - v^2TT') = \gamma^2(cTcT' - v^2TT'), \tag{4.9}$$

Simplifying the equation, we obtain:

$$\gamma = \frac{1}{\sqrt{1 - v^2 / c^2}}, \tag{4.10}$$

This is an equation that is independent of distance coordinates and time coordinates. Therefore, our earlier conjecture about the existence of a γ that satisfies both equations (4.3) and (4.4) simultaneously is valid. γ is indeed the Lorentz factor.

By substituting equation (4.10) into equations (4.4) and (4.5), and replacing T with t, X with x, and X' with x', we obtain the general form of the Lorentz transformations from the S frame to the S' frame.

$$t' = \gamma(t - vx / c^2), \tag{4.11}$$

$$x' = \gamma(x - vt), \tag{4.12}$$

The Lorentz transformation from the S' frame to the S frame is given by:

$$x = \gamma\left(x' + vt'\right), \tag{4.13}$$

$$t = \gamma(t' + vx'/c^2), \tag{4.14}$$

As a result, the Lorentz factor establishes a connection between the time and distance coordinates in the S and S' frames, allowing for the conversion of distance and time coordinates between them. The Lorentz transformations are based on the premise that the speed of light is constant and equal to c in any inertial reference frame. From equations (4.1) and (4.2), it can be seen that the Lorentz transformations involve the addition of the speed of light and the velocity of the reference frame. Clearly, different reference frames must have their own "local time scale" and "local distance scale" in order for the constancy of the speed of light c to hold in any inertial reference frame. In other words, the essence behind the constancy of the speed of light c is the difference in the time and distance scales of each reference frame.

The Lorentz transformations reflect the differences in time calculations for the same event in different reference frames.
We know that Einstein derived the theory of special relativity based on the Lorentz transformations. However, despite their different mathematical forms, we may wonder if the time calculated by each transformation is consistent with each other.

4.3 Coordinate Transformation Based on Galilean Transformations

If observers in S and S' use Galilean transformations to calculate the time it takes for light to propagate in S', denoted as T1 and T2 respectively, and then compare the relationship between T1 and T2, what would the result be? Following this line of thinking, we conducted an analysis.

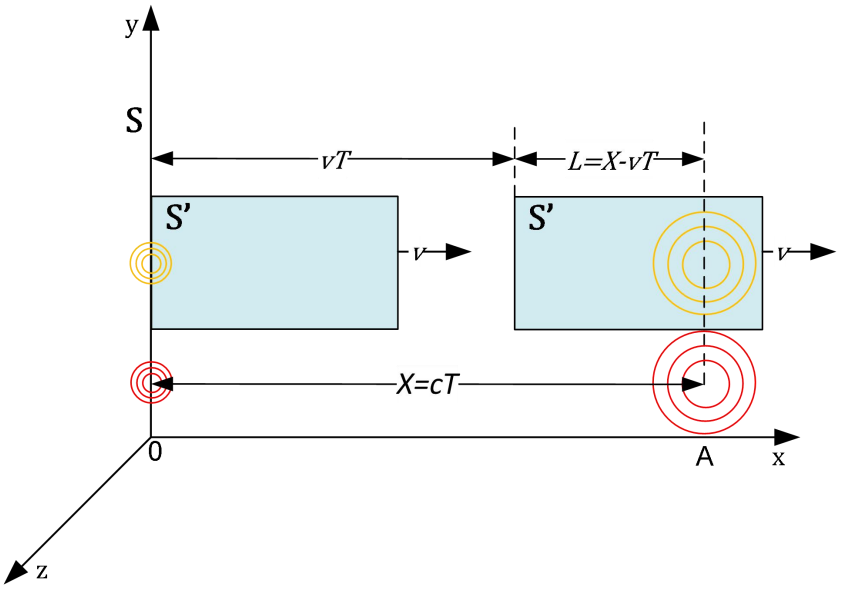


Figure 4.3: Inertial Reference Frame Model in Galilean Transformations

As shown in Figure 4.3, in the S reference frame, light takes time T to reach point A, resulting in:

$$X = cT\,, \tag{4.15}$$

Since the speed of light in S' is equal to c, according to the Galilean transformations, observers in the S reference frame would naturally assume that the speed of light in S' would be the sum of the velocity of S' and the speed of light in S, resulting in a relative speed of c + v for light in S' with respect to S. Therefore, we have:

$$vT_1 + cT_1 = cT\,, \tag{4.16}$$

Thus, the time required for distance L in Figure 4.3 can be calculated as:

$$T_1 = cT / (c+v)\,, \tag{4.17}$$

Next, let's calculate the time T2 required for distance L from the perspective of S' as:

$$T_2 = L / c \;\; = (X - vT) / c = (c - v)T / c\,, \tag{4.18}$$

By using equations (4.17) and (4.18), we obtain:

$$T_2 = (c^2 - v^2) / c^2 * T_1\,, \tag{4.19}$$

The analysis above reveals that S considers S' to have the same time and distance scales as itself, leading to the belief that the speed of light in S' relative to S is c + v. Then, based on the classical Galilean transformations, the time T1 is calculated.

Similarly, S' also considers its own time and distance scales to be the same as S and calculates T2 using Galilean transformations. That is, under the assumption that S and S' perceive each other's distance and time scales to be the same, they independently calculate the time required for light to travel distance L. However, in order to maintain the constancy of c, their time and distance scales must be different. Therefore, equation (4.19) represents the result under the dual influence of the inconsistent time and distance scales between S and S'.

We know that speed is defined as distance divided by time. Therefore, redefining the scales of distance and time (localization) can change the numerical value of speed. Let's consider a simple example: if we redefine the concept of a second, such that the new definition of 1 second is equivalent to the previous 2 seconds, then the speed will be doubled compared to before.

Next, let's analyze how the scales of time and distance determine speed.

In S, we use Len to represent the distance covered by light in Time, resulting in:

$$c = Len / Time , \tag{4.20}$$

Assuming that the localized distance Len' in S' is K times the localized distance Len in S, we have:

$$Len' = Len * K , \tag{4.21}$$

Therefore, considering that the distance in S' has become Len * K due to the localized distance, when divided by c, S' would require K times the time, i.e., Time * K. Furthermore, from the equation c = Len' / Time', in order to maintain the constancy of c, if the distance scale becomes K times, the time scale also needs to become K times. Hence, under the dual influence of time and distance scales, the time in S' is K * K times that in S. Thus, according to the respective time and distance scales in S and S', we have:

$$Time' = Time * KK , \tag{4.22}$$

For example, let's consider the time scale in A as s = 1 and the distance scale as 1. In B, the time scale is s' = 0.8, and the distance scale is 0.8.

This means that the ruler in B has become shorter. In B, 1 meter corresponds to only 0.8

meters in A. Similarly, 1 second in B corresponds to only 0.8 seconds in A.

Now, if we measure a distance L in A, the time it takes for light to travel this distance is Ta = (L/c) s. From B's perspective, the length of this distance is L * 0.8, and the time it takes for light to travel it is

$$T_b = (L*0.8/c)\ s' = (T_a*0.8*0.8)\ s\ , \tag{4.23}$$

Therefore, from equations (4.19) and (4.23), we obtain:

$$K^2 = (c^2 - v^2)/c^2\ , \tag{4.24}$$

$$K = \sqrt{(c^2 - v^2)/c^2}\ , \tag{4.25}$$

The relationship between K and the Lorentz factor γ is given by:

$$K = 1/\gamma \tag{4.26}$$

In equation (4.18), T2 represents the time calculated in the distance scale of S, where L is given in the numerical value of the S scale. Now, we want to switch it to the distance scale of S', using S' scale to measure it. Since the scale of S' is K times that of S, the numerical value of distance L needs to be divided by K in the scale of S'. In simpler terms, when the ruler becomes shorter, the numerical values measured by the ruler will become larger. Therefore, we need to replace L with L' = L/K. Thus, we can calculate the required time T2' in the distance scale of S', resulting in:

$$T_2' = L'/c = L/K/c = T_2/K = T(c-v)/K/c\ , \tag{4.27}$$

Simplifying, we obtain:

$$T_2' = \sqrt{(c^2 - v^2)/c^2} * T_1\ , \tag{4.28}$$

Thus, we have obtained the relationship between the time T2' calculated in the distance scale of S' and the time T1 calculated in the distance scale of S. In form, equation (4.28) is consistent with the time transformation equation in special relativity [11]. Based on the constancy of the speed of light c, we can also derive the distance transformation equations for S and S' in their respective time scales:

$$L' = \sqrt{(c^2 - v^2)/c^2} * L\ , \tag{4.29}$$

Under the assumption that S and S' perceive each other's distance and time scales to be the same as their own, we have derived the time and distance equations that are

consistent with special relativity using the Galilean transformations. Therefore, we have reason to believe that the underlying mathematical logic behind special relativity is the same. Equations (4.28) and (4.29) represent the results under the dual influence of the inconsistent time and distance scales between inertial reference frames.

Special relativity describes the differences in time calculations for the same event in the same reference frame observed by observers in different reference frames.

4.4 Differences and Similarities between Lorentz Transformations and Special Relativity

Now we can answer the reason why Lorentz transformations and special relativity are mathematically inconsistent. It is because they have different mathematical meanings. Lorentz transformations describe the differences in time calculations for the same event in different reference frames. Special relativity, on the other hand, describes the differences in time calculations for the same event observed by observers in different reference frames.

Lorentz transformations and special relativity both reveal a mathematical logic: the differences in time and distance scales between inertial reference frames result in different time calculations. Therefore, by constructing different time and distance scales, we can ensure that an object has the same velocity value in their respective inertial reference frames.

Let's consider an interesting example. A train with a long carriage is moving uniformly in a straight line on a railway track with a velocity v. When the train passes position P1, two identical bullets are fired towards position P2 in the direction of the train's velocity with a speed u. Both bullets arrive at P2 simultaneously. This is illustrated in Figure 4.4. Observer A measures the velocity of the bullets from the ground, while observer B measures the velocity of the bullets from inside the train carriage. They both obtain the same numerical value, indicating that the velocity of the bullets in their respective inertial reference frames is equal to u.

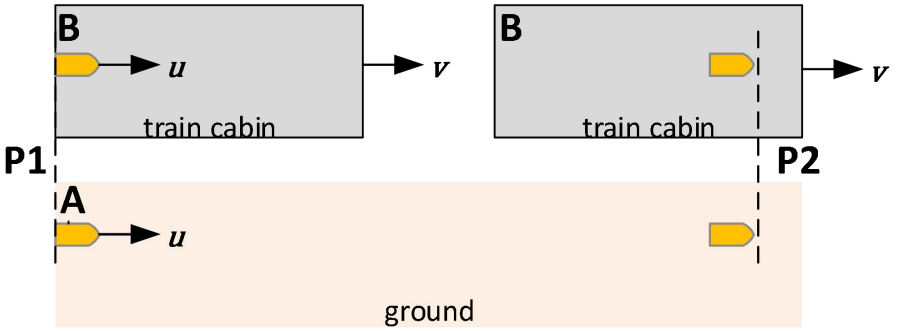


Figure 4.4: Time of the Bullets

A calculates that the time required for the bullet to reach P2 from the ground is T. According to the information provided by B, the velocity of the bullet relative to the train carriage is u. Therefore, A calculates that the time required for the bullet to reach P2 from inside the train carriage is also T.

$$T_1 = uT/(v+u), \tag{4.30}$$

Based on the information provided by A, B also knows that the bullet inside the train carriage has traveled a distance of uT - vT relative to the carriage. Therefore, B calculates that the time required for the bullet inside the train carriage to reach P2 is also T.

$$T_2 = (uT - vT)/u, \tag{4.31}$$

Thus, we obtain:

$$T_2 = (u^2 - v^2)/u^2 * T_1, \tag{4.32}$$

As we can see, equation (4.32) is identical in form to equation (4.19). Therefore, we can directly write the following equation based on (4.28):

$$T_2' = \sqrt{(u^2 - v^2)/u^2} * T_1, \tag{4.33}$$

By the same reasoning, the bullet example is also applicable to Lorentz transformations. We can use Lorentz transformations to calculate the time T' for the bullet inside the train carriage, and then use special relativity to calculate the time T2' for the bullet inside the train carriage. We can compare T' and T2' and if our analysis is correct, they should yield the same numerical value. Let's substitute specific values.

Assuming u = 50 m/s, v = 30 m/s, and T = 100 s. From equation (4.30), we have:

$$T_1 = 50*100/(50+30) = 62.5\,, \tag{4.34}$$

From equation (4.33), we obtain:

$$T_2' = \sqrt{\left(50^2-30^2\right)/50^2}\,*T_1 = 0.8*T_1 = 50\,, \tag{4.35}$$

The time calculated by B inside the train carriage, 40 s, is actually the same as the time calculated by A outside the carriage, 62.5 s. Although their numerical values appear different, they represent the same time.

We can also apply the "bullet" example to Lorentz transformations. From equation (4.11), we have:

$$T' = \gamma(T - vuT/u^2)\,, \tag{4.36}$$

Substituting u = 50 m/s, v = 30 m/s, and T = 100 s, we have:

$$T' = 5/4*\left(100-30*50*100/50^2\right) = 50\,, \tag{4.37}$$

From (4.35) and (4.37), we can see that the results obtained through Lorentz transformations are consistent with those obtained through special relativity. We can continue to substitute other data, such as the values in Table 4.1:

u, v, T	Lorentz Transformation T’	Special Relativity T2’
u=50 m/s, v=30 m/s, T=100 s	50 s’	50 s’
u=50 m/s, v=40 m/s, T=100 s	33.33 s’	33.33 s’
u=17m/s, v=8 m/s, T=100 s	60 s’	60 s’
u=13 m/s, v=5 m/s, T=100 s	66.67 s’	66.67 s’

Table 4.1: Time in the S' frame (s' represents seconds in the S' frame)

We can see that the time T2' calculated using the special relativity time formula is consistent with the time T' calculated using the Lorentz transformation formula. Although these two equations have different mathematical forms, the special relativity equation establishes the relationship between T2' and T1, while the Lorentz transformation establishes the relationship between T' and T. Both T2' and T' refer to time in the S' frame.

In simpler terms, when an event "Event" occurs, according to the Galilean transformation:

A calculates the time Event T1 of this event in A and the time Event T2 required in B,

while B also calculates the time Event T3 of this event in B.

The relationship between Event T1 and Event T3 is the Lorentz time transformation relationship.

The relationship between Event T2 and Event T3 is the special relativity time transformation relationship.

Therefore, mathematically, Lorentz transformation and special relativity are bound to be different, but the final result must be the same.

It may seem that the constancy of bullet velocity in an inertial reference frame can also be derived from special relativity. However, we know that the constancy of the speed of light is the most important assumption in special relativity, and it introduces the concept of time dilation. So, does time actually dilate? According to our previous analysis, the reason for the numerical differences in time in different reference frames is due to their respective time and distance scales. In reality, their times are completely equal. However, if this adjustment of time and distance scales is not consciously made, then time dilation holds true. Otherwise, the Lorentz transformation and special relativity are merely mathematical transformations of spacetime coordinates, and time does not dilate.

The cause of this physical debate was the Michelson-Morley experiment, and Einstein provided a conscious "bold assumption" to explain it. However, this assumption is merely a mathematical hypothesis and does not reflect physical reality.

4.5 Conclusion of the Time Dilation Game

The results of the Michelson-Morley experiment (MMX) negated theories of an absolute stationary ether and a partially dragged ether. Only the scenario where the ether is completely dragged by the Earth could reasonably explain the MMX. The stellar aberration phenomenon was considered as a rejection of the theory of completely dragged ether. However, as we analyzed in the previous chapter, if you carefully study the research on ether during the 19th century, you will find that the answers were already provided at that time. The experiments conducted by Airy and others directly refuted the classical explanations of the stellar aberration phenomenon put forth by Bradley and Young [12][13], as well as the explanations of special relativity. The relevant content can also be found here [14].

If it had been realized at that time that the resistance of the ether around the Earth might

be non-uniform, the fate of the theory of completely dragged ether would have been different. However, in that case, we would not have witnessed the development of Lorentz transformations and special relativity, and physics would have continued along a classical trajectory.

If you insist that time slows down in the moving frame S', you will fall into a paradoxical dilemma. If we consider S as stationary and S' as moving, we can conclude that time in S' slows down. Similarly, if we consider S' as stationary and S as moving, we can conclude that time in S slows down. This appears to be highly contradictory. However, if you understand one thing: these are simply the results of the different time and distance scales in each inertial reference frame, then you won't truly believe that time is slowing down. The Time Dilation Game should come to an end.

4.6 Summary of Lorentz Transformations and Special Relativity

Lorentz transformation describes: An observer A calculates the time differences of the same event in different reference frames.

Special relativity describes: Observers A and B in different reference frames calculate the time difference of the same event within the same reference frame.

Therefore, they have differences in their mathematical forms, but the final calculation results are consistent. They both reveal a mathematical logic: the differences in time and distance scales between inertial reference frames lead to differences in the numerical values of time and distance calculations. We can perform transformations of spacetime coordinates using either Lorentz transformations or special relativity.

We must understand that both Lorentz transformations and special relativity are merely mathematical transformations and not physical entities. They are like converting currencies, where we can convert spacetime coordinates, but they are equivalent. We should not feel that possessing 100 billion Zimbabwean dollars makes us wealthier than Elon Musk. We should not focus solely on numbers and overlook the underlying scales. Nevertheless, we must express gratitude to great scientists like Michelson, Morley, Lorentz, Einstein, and others who have made outstanding contributions to exploring the unknown and advancing the development of natural science. However, we must also stand on the shoulders of giants to continue our exploration, to refine and discover what humanity has already achieved, and to actively explore the unknown.

Light can be "dragged" by a gravitational field, and an uneven gravitational field can cause

light to refract, whether this process is achieved directly through the gravitational field or indirectly through the ether. This can explain the Michelson-Morley experiment and stellar aberration. So, how does light get "dragged" by a gravitational field, and how is it refracted? This requires further research on light. Next, we need to understand where the energy of light comes from.

We will continue to delve into the most common natural phenomenon in the universe, "light," following in the footsteps of our predecessors.

Chapter 5
Source of Light Energy

Classical physics tells us that light is a kind of electromagnetic wave, which has the dual nature of wave and particle, and the speed of light in vacuum is equal to c. So where does the energy that drives the propagation of light come from? We need to find the answer from the electromagnetic wave characteristics of light.

5.1 Electromagnetic Wave Characteristics of Light

Visible light is a high-frequency electromagnetic wave, and it is challenging to artificially generate a segment of visible light wave point by point in the time domain. However, generating low-frequency electromagnetic waves in the time domain is relatively easy. Therefore, by studying low-frequency electromagnetic waves, we can clearly demonstrate the details of light in the time domain, and further reveal the source of energy that drives the propagation of light. As we know, charges generate electric fields, and when voltage is applied to a conductor, it affects the charge distribution, thereby changing the intensity and distribution of the electric field. The electric field intensity is proportional to the applied voltage. Therefore, by changing the voltage, we can synchronously alter the electric field.

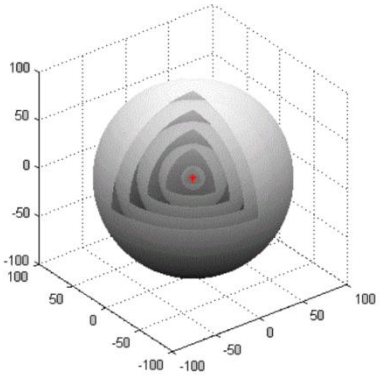


Figure 5.1: Light propagates in the form of spherical waves.

The electric field propagates outward in the form of spherical waves, as shown in Figure 5.1, and its intensity is proportional to the voltage. Therefore, the curve representing the change of the electric field over time exhibits the same waveform as the curve

representing the change of voltage. The varying electric field presents alternating bright and dark stripes, where bright stripes indicate strong electric field intensity and dark stripes indicate weak electric field intensity, as illustrated in Figure 5.2. When the frequency of the alternating bright and dark stripes falls within the range perceptible by the human eye, it becomes visible light.

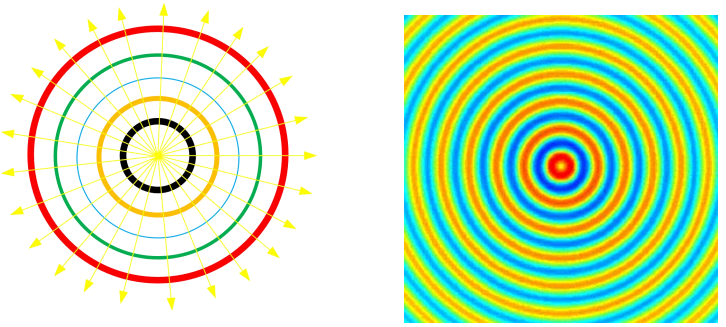


Figure 5.2: Light and dark stripes caused by changes in electric field intensity.

Therefore, it can be determined that the electric field plays a decisive role in the formation and propagation of light. The energy of the electric field directly drives the propagation of light. Furthermore, the propagation speed of the electric field determines the speed of light in a vacuum.

The principle of how atoms emit light is similar. The electrical neutrality of an atom is related to the charge distribution of its electrons. Ideally, the positive electric field of the atomic nucleus and the negative electric field of the electrons can cancel each other out beyond a certain distance, making the atom exhibit the characteristic of electrical neutrality. As shown in Figure 5.3.

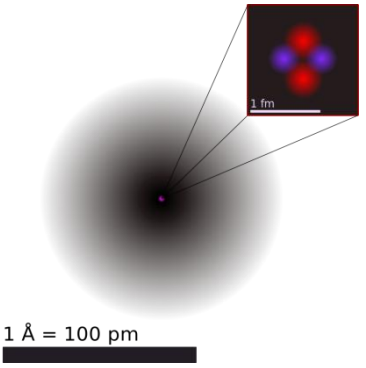


Figure 5.3: Atomic Model

When an electron absorbs energy from an external electromagnetic wave, the electric field of the electron will fluctuate. This occurs because the absorption of energy leads to a change in the probability distribution of the electron's charge, which subsequently causes a corresponding change in the electric field. This brief fluctuation in the electric field results in the atom losing its electrical neutrality and releasing a segment of an electromagnetic wave. However, once the electron's energy returns to normal, the electric field fluctuation ceases, and the atom regains its electrically neutral state. This process is described in quantum mechanics.

5.2 Quantum Mechanical Explanation of Electromagnetic Waves

According to quantum mechanics, electrons exist in different energy levels within an atom, as shown in Figure 5.4. When the external energy matches the energy difference between the electron's energy levels, the electron is excited to a higher energy level. In this higher energy level, the electron is in an unstable state and thus quickly returns to a lower energy level. During this transition, the electron releases the energy difference, which propagates as a photon, forming an electromagnetic wave. The generation of this photon manifests as a fluctuation in the electron's electric field. Once the electron's energy returns to normal, the atom regains its electrical neutrality. However, even when the electron is not disturbed by external factors, due to the probabilistic nature of its distribution, the electric field generated by the electron cannot completely cancel out the electric field generated by the atomic nucleus. Therefore, atoms generally emit low-frequency electromagnetic waves, such as infrared light.

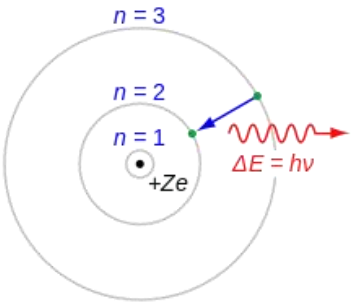


Figure 5.4: Electron Energy Level Orbitals

It seems that the energy of the electric field directly drives the propagation of light, and the light's alternating bright and dark stripes reflect the changes in the electric field's energy.

Now, we already know that the energy of the electric field directly drives the propagation of light, and the propagation speed of the electric field determines the speed of light in a vacuum. So, does the propagation of light require a medium? Or what kind of effect does a medium have on the propagation of light? The Fizeau experiment provides us with the answer.

Chapter 6
Fizeau Experiment

The Fizeau experiment [2][15][16][17][18], conducted by Hippolyte Fizeau in 1851, measured the relative speed of light in moving water. Based on the characteristics of light's speed in a medium obtained from the Fizeau experiment and the particulate nature of light, we have constructed a physical model that describes energy transfer through particles under the combined effects of thrust from the field energy and resistance from the medium. The speed of light in a moving medium represents the speed at which the electric field energy is transmitted through particles in that medium. When this velocity reaches a certain value, the thrust from the electric field energy and the resistance from the medium reach a balance. The particulate nature of light plays a pivotal role in this physical model. In the following, we will elaborate on this in detail.

6.1 Particulate Nature of Light

According to classical physics, light possesses the dual nature of wave and particle, exhibiting both wave-like and particle-like properties. As a wave, light can propagate and exhibit wave phenomena such as interference, diffraction, and refraction, possessing wave characteristics like wavelength, frequency, and amplitude. However, light also exhibits particle-like properties, referred to as photons. Photons, as the energy quanta of light, possess discrete energy and momentum. Experimental evidence such as the photoelectric effect and Compton scattering confirms the particulate nature of light. The particulate nature of light is significant in studying the physical mechanisms of light propagation in media.

How did the particle properties of light come about? There are two possible photon physical models that can manifest the particle properties of light.

The first possibility is that the particle properties of light arise from an "condensation" of electric and magnetic fields to form countless tiny energy particles, which we can call etons. Etons move at the speed of light with energy and interact with each other. For example, if the speed of an eton in the front decreases, the eton behind will directly or indirectly "collide" with the one in front, thus creating propulsion. These eton particles formed by the "condensation" of electromagnetic and magnetic fields can make light

exhibit particle properties. However, this eton model obviously appears more like a mathematical model imagined to explain the particle properties of light. The idea of energy "condensing" into particles seems like a reasonable explanation, but it is not entirely accurate. But using the eton model to explain the unknown photons moving at the speed of light is a feasible choice.

The second possibility is that there exists some unknown particles in space, which we can call xtons. The energy of the electric field is transmitted through xtons, and the existence of xtons allows light to exhibit particle properties. Xtons act as a kind of medium, so they do not need to move with light; they simply transmit energy. In space, xtons only vibrate in response to changes in the electric field energy. When the amplitude of vibration of the leading xton decreases, the xton behind will exert "propulsion" on the front one. The electric field energy is transmitted at the speed of light through xtons, thus forming photons that move at the speed of light.

The eton and xton are two different physical models. Etons move at the speed of light (c), while xtons only vibrate in place. However, they also share common characteristics. When etons maintain a constant speed, they are relatively stationary with respect to each other. When the speed of etons changes, they are no longer stationary, and their distances from each other change accordingly. Similarly, for xtons, when the electric field energy is stable, xtons are relatively stationary with respect to each other. When the electric field energy changes, the distances between xtons also change. In other words, when the speed or vibration amplitude of the leading particles decreases, the particles behind exert "propulsion" on the front ones, thus achieving energy transfer between particles. Since we already know that the energy of the electric field directly propels the propagation of light, fundamentally, when the state of photons changes, the electric field exerts a propulsive force on them. It can be said that the study of the particle properties of light in understanding the physical mechanisms of light propagation in media is of significant importance.

When a photon with a speed of c enters a medium, how does the speed of the photon change? Next, we will analyze the Fizeau experiment. The Fizeau experiment can be seen as a key to unlocking the microcosm of light.

6.2 Introduction to Fizeau Experiment

Fizeau employed a special interferometer apparatus to measure the effect of medium movement on the speed of light. According to the prevailing theories at that time, light

passing through a moving medium would be dragged by the medium, and thus the measured speed of light would be a simple sum of its speed through the medium and the speed of the medium itself. While Fizeau did indeed detect a dragging effect, the magnitude of the effect he observed was far lower than expected. In the following, a brief analysis and description of the Fizeau experiment will be provided.

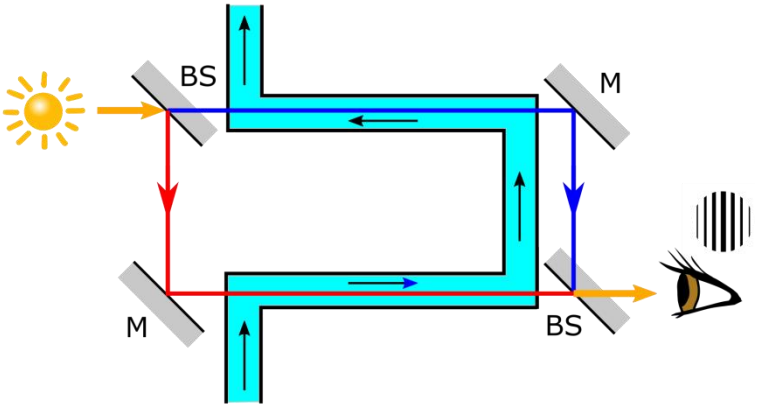


Figure 6.1: A highly simplified representation of the Fizeau experiment.

Figure 6.1 depicts a highly simplified representation of Fizeau's experiment conducted in 1851. The incident light is split into two beams by a beam splitter (BS) and travels through two water columns flowing in opposite directions. Then, the two beams are recombined to form an interference pattern that can be interpreted by the observer.

Assuming that the water flows through the tubes with a velocity of v. According to the non-relativistic theory of luminiferous ether, the speed of light should increase or decrease depending on the direction as the light is "dragged" by the water through the ether frame. Based on Stokes' hypothesis of complete ether drag, the total velocity of the light beam should be a simple sum of its speed through the water and the speed of the water. That is, if n is the refractive index of water, and c/n is the speed of light in still water, then the predicted speed of light, w, in a single arm would be:

$$w_{+} = c / n + v \,, \tag{6.1}$$

The predicted speed in the other arm is

$$w_{-} = c / n - v \,, \tag{6.2}$$

Therefore, light traveling against the flow of water should be slower than light traveling with the flow of water. When the light is recombined at the observer's location, the

interference pattern between the two beams depends on the transit time through both paths and can be used to calculate the speed of light as a function of the water velocity. Fizeau found that

$$w_{+} = c/n + v(1-1/n^2)\,, \tag{6.3}$$

In other words, light does seem to be dragged by the water, but the magnitude of the dragging effect is far lower than expected. The results of the Fizeau experiment were precise, and later, many physicists improved upon the experiment, obtaining consistent conclusions with Fizeau's findings. The Fizeau experiment negated the hypothesis that the medium can completely drag light, but from the experimental data, it seems that the speed of light is indeed partially dragged by the medium. So, how does the medium actually affect the speed of light's propagation? We need to analyze the physical mechanisms behind it.

Since light possesses a particulate nature, we will conduct our research by examining the propagation of particles in media [19][20]. Particles, like light, do not require the presence of media such as water or glass for their movement; they only encounter obstacles in their path.

6.3 Propagation of Particles in Media

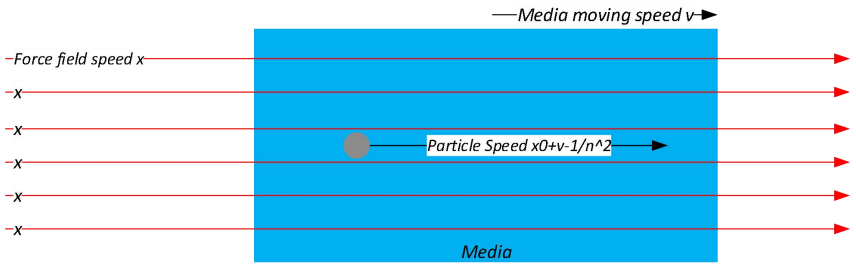


Figure 6.2: The velocities of the force field, medium, and particle in reference to the Earth

As shown in Figure 6.2, assuming there is a stationary force field source S, and the speed of the force field in the air is x. Now, imagine a particle A, disregarding the influence of gravity, which experiences only the propulsive force F exerted by the force field. The speed of particle A relative to S is v_{A2S}. The relative speed (x - v_{A2S}) between particle A and the force field affects the effectiveness of the force field's action on the particle, specifically influencing the magnitude of the propulsive force F. This influence can be

mathematically described in a manner similar to the Doppler effect. We establish a function F(x - v_{A2S}) with (x - v_{A2S}) as a parameter to represent the magnitude of the propulsive force F. When v_{A2S} = x, the relative speed between particle A and the force field becomes zero. At this point, the force field no longer exerts any force on particle A, indicating

$$F(x-v_{A2S}) = F(x-x) = 0 \text{ ,} \tag{6.4}$$

when v_{A2S} = 0, the relative speed between particle A and the force field is x. Let's assume that at this moment, particle A experiences a propulsive force of F0, get

$$F0 = F(x-0) = F(x) \tag{6.5}$$

According to the Doppler effect, we can express the general form of the function F(x - v_{A2S}) as follows:

$$F(x-v_{A2S}) = F0*(x-v_{A2S})/x \text{ ,} \tag{6.6}$$

we introduce the thrust coefficient R = F0/x, and thus we obtain

$$F(x-v_{A2S}) = R*(x-v_{A2S}) \text{ .} \tag{6.7}$$

By the same principle, when particle A enters a certain medium, there is also a Doppler effect caused by the relative motion between particle A and the medium. When the speed of particle A relative to the medium is 0, A will not experience any resistance from the medium. When the speed of particle A relative to the medium is x, the resistance experienced by particle A is represented by f0. Let's denote the speed of particle A relative to the medium as v_{A2M} , and the resistance experienced as f(v_{A2M}). Based on the Doppler effect, we can express it as follows:

$$f(v_{A2M}) = f0*v_{A2M}/x \text{ .} \tag{6.8}$$

We introduce the medium resistance coefficient K = f0/x, and thus we obtain

$$f(v_{A2M}) = K*v_{A2M} \text{ .} \tag{6.9}$$

Now, let particle A accelerate in the air under the action of the propulsive force F. When

the speed v_{A2S} of particle A reaches the speed of the force field, x, the force field no longer exerts any force on particle A. Particle A will then maintain a constant speed in a straight-line motion. Next, let particle A enter a medium that is stationary relative to the ground. A will experience resistance from the medium, and let's assume that its speed becomes x0 = x/n. Substituting v_{A2M} = x0 into equation (6.9), the resistance experienced by particle A is given by

$$f(x0) = K * x0 = K * x / n \quad (6.10)$$

Since both the medium and S are stationary relative to the ground, the speed of particle A relative to S is equal to its speed relative to the medium. Substituting v_{A2S} = x0 into equation (6.7), the propulsive force exerted by the force field on particle A is given by

$$F(x - v_{A2S}) = R * (x - x0) = R * (x - x / n) = R * x * (1 - 1 / n) \quad (6.11)$$

Under the combined action of the propulsive force F and the resistance force f, particle A maintains a constant speed in straight-line motion, achieving an equilibrium state. At this point,

$$F(x - x0) = f(x0) = R * (1 - 1 / n) = K * c / n \ , \quad (6.12)$$

get

$$R * (n - 1) = K \quad (6.13)$$

Thus, we have obtained the relationship between the propulsive force coefficient R and the medium resistance coefficient K. However, we must be clear that both R and K are measured and calculated in a stationary medium. Once the medium is no longer stationary, if we want to continue using R and K, we must switch the reference frame to the moving medium.

Now, let's give the medium a horizontal speed v relative to the ground. As a result, the speed of particle A relative to the medium becomes x-v. Since n is measured in a stationary medium, with the Earth as the reference frame, when the motion state of the medium changes, n may also change. However, if the medium is taken as the reference frame and returns to a 'stationary' state, then n does not need to change. Therefore, when the particles return to a state of balanced uniform linear motion, we can attempt to find a mathematical expression relating n and the velocity v of the medium to describe the

speed of particles in a moving medium. Based on this expression, we can also calculate n' with the Earth as the reference frame.

Based on the above analysis, if the medium is moving at a speed of v, then with the medium as the reference frame, at the moment the medium starts moving, the speed of particle A changes to x/n - v/n. In other words, relative to the balanced state in a stationary medium, particle A gains a velocity of -v/n. As long as particle A is in the reference frame of the medium, compared to the speed of particle A with the Earth as the reference frame, it needs to add -v/n. According to equation (9), the resistance experienced by particle A from the medium changes by -Kv/n. However, since the relative speed between the force field and particle A remains unchanged, the propulsive force F does not change. As F is greater than f, particle A's speed will increase. As particle A's speed increases, the resistance force f from the medium will also increase, while F will gradually decrease. When the decrease in F and the increase in f accumulate to a value of -Kv/n, particle A will return to the equilibrium state of constant speed in straight-line motion. This process involves redistributing the newly acquired speed of -v/n. So, how is this additional speed of -v/n "divided"?

Suppose when particle A undergoes a change in speed dx while moving in the medium, its change in speed relative to the force field is DX. When it returns to the equilibrium state, it satisfies:

$$F(x - x0 + DX) = f(x0 + dx), \tag{6.14}$$

$$R*(x*(n-1)/n + DX) = K*(x/n + dx), \tag{6.15}$$

expanding the equation, we obtain:

$$R*x*(n-1)/n + R*DX = K*x/n + K*dx, \tag{6.16}$$

eliminating equal terms on both sides, we obtain:

$$R*DX = K*dx, \tag{6.17}$$

from equation (6.13), we obtain:

$$DX = (n-1)*dx, \tag{6.18}$$

In other words, when particle A undergoes a speed change of dx while moving in the medium, the change in speed relative to the force field is (n-1) times dx, and this change is

in the same direction. dx and DX "divided" the value of -v/n, and thus,

$$dx + DX = -v / n \,, \tag{6.19}$$

substituting DX into equation (6.19) and rearranging, we obtain:

$$dx + (n-1) * dx = -v / n \,, \tag{6.20}$$

get

$$dx = -v / n^2 \,. \tag{6.21}$$

Therefore, with the medium as the reference frame, the speed of particle A is given by:

$$x / n - v / n^2 \,. \tag{6.22}$$

If we take the ground as the reference frame, the speed of particle A needs to be further added with the speed v relative to the ground of the medium, resulting in:

$$x / n + v - v / n^2 \,. \tag{6.23}$$

In this way, we have obtained a mathematical expression regarding n and the velocity v of the moving medium. Through this expression (23), we can also calculate n' with the Earth as the reference frame, yielding:

$$n' = x / (x / n + v - v / n^2) \tag{6.24}$$

It can be observed that as long as the refractive index (n) remains constant and the speed (v) of the medium's movement remains unchanged, the speed of light in the medium will remain constant. The equation (6.23) and Fizeau's experimental result (6.3) appear to be consistent in form. So, is the principle behind the propagation of light in a medium the same as the principle behind the movement of particles in a medium?

6.4 Propagation of Light in Media

We know that light has particle characteristics. Regardless of whether we use the eton or xton particle model to realize the transmission of light energy, the electric field energy is transmitted at the speed of light with the help of particles, thus forming photons moving at the speed of light.

Of course, we still don’t know which physical model is closer to the real photon? I think it may be that the propagation of the electric field is closer to the reality with the help of some unknown substance xton. This substance reflects the characteristics of particles. Maybe this is the ether that physicists such as Fizeau were looking for in the 19th century, or maybe this is the quantum described in quantum mechanics. To study the propagation

of photons in a moving medium driven by an electric field, we can refer to the propagation process of particles in a medium. We only need to replace the particles in Figure 6.2 with photons and the force field with an electric field.

6.5 Proof of the Fizeau Experiment in Special Relativity

The conclusion of the Fizeau experiment can also be proven using the relativistic formula for velocities addition [21][22]. According to the relativistic formula for velocities addition, we can obtain the speed of light in a moving medium as V_{lab}:

$$V_{lab} = \frac{\frac{c}{n} + v}{1 + \frac{\frac{c}{n} v}{c^2}} = \frac{\frac{c}{n} + v}{1 + \frac{v}{cn}} \quad . \tag{6.25}$$

It can be seen that when the speed of the medium relative to the ground is v=0,

$$V_{lab} = c / n \quad . \tag{6.26}$$

This is consistent with the actual result. When v is equal to the speed of light,

$$V_{lab} = \frac{c / n + c}{1 + \frac{c}{cn}} = c \quad . \tag{6.27}$$

It can be seen that this is also consistent with the actual result. When the speed of the medium is equal to the speed of light, light is no longer affected by the medium. Since the speed of light and the speed of the medium are equal, light has no opportunity to penetrate into the interior of the medium, and the medium can be considered as non-existent. Now let's analyze the effect of n on V_{lab}. When n approaches infinity:

$$V_{lab} = v / 1 = v \quad . \tag{6.28}$$

This is in accordance with the actual result. Let's take a look at the case when n equals 1, i.e., when the medium has no resistance to the passage of light.，

$$V_{lab} = \frac{c + v}{1 + v / c} = c \quad . \tag{6.29}$$

This result is also as expected. Let's subtract c/n from equation (6.25), resulting in:

$$V_{lab}-\frac{c}{n}=\frac{\frac{c}{n}+v}{1+\frac{v}{cn}}-\frac{c}{n}=\frac{v(1-\frac{1}{n^2})}{1+\frac{v}{cn}}\approx v(1-\frac{1}{n^2}), \quad (6.30)$$

We can see that the premise for the final approximation calculation is v << c. However, when v=c, according to equation (6.27), V_{lab} = c, which is consistent with reality. Now, substituting V_{lab} into equation (6.30), we obtain:

$$V_{lab}-c/n=c-c/n, \quad (6.31)$$

This result clearly does not equal the approximate value $v(1-\frac{1}{n^2})$ in equation (6.31). Therefore, such an approximation cannot be made when v is relatively large. However, in the case of low speeds, the relativistic formula for velocities addition is correct. It can be said that under the assumption that the speed of the medium is not too large, the Fizeau experiment can effectively verify the correctness of the special theory of relativity. Einstein gave a very high evaluation of the Fizeau experiment [10].

The explanation based on the relativistic formula of velocity addition is well-known and currently accepted. However, we must recognize that this is an approximate conclusion, valid under the premise that the relative velocity of the medium with respect to the speed of light can be neglected. This prompts us to consider and provide an alternative explanation for the Fizeau experiment. If we view the Fizeau experiment as a mathematical puzzle, then I believe having an additional approach will be more advantageous for understanding the problem. If we liken the principle of adding relativistic velocities to a road leading to Rome, then what we are doing is laying down another path to Rome.

6.6 Experimental Verification

We explain the speed characteristics of light in moving media based on classical mechanics theory. However, such an explanation may raise doubts: 'The derivation regarding particle propagation in the medium is at best a heuristic method (based on a mechanical image). Without further relevant evidence to support the assumed mechanism, its effectiveness cannot be proven.' This prompted us to design an experiment for verification. As shown in Figure 6.3:

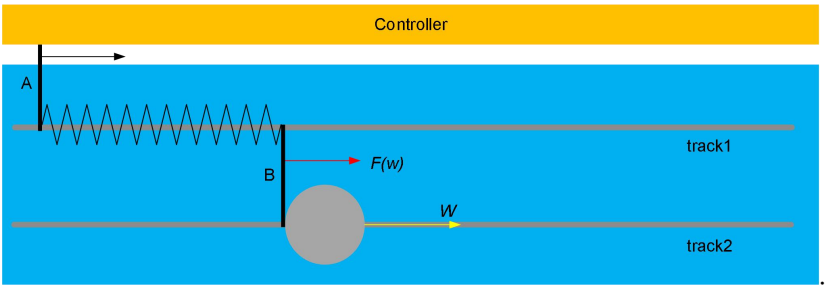


Figure 6.3: Experiment to Measure the Speed of a Ball Moving in Water Driven by the Force F(w)

A spring is placed on a smooth horizontal track 1, with two dynamic rods A and B fixed at the ends of the spring. The mass and size of the spring and dynamic rods are negligible. By moving dynamic rod A, the controller compresses the spring length, with the compression length of the spring being precisely monitored by the controller. This results in a linear relationship between the thrust F(w) output by dynamic rod B and the speed of the ball. When the speed of the ball reaches the maximum set moving speed x of dynamic rod A, the stable extension length of the spring is 0. When the speed of the ball is 0, the compression amount of the spring should reach the set maximum value dLmax. In this way, we simulate the force field's thrust on the particle using F(w).

With the ground as the reference frame, the velocity of the water flow is v, and the velocity of the ball in the water is w. We need to calculate the thrust that the force field applies to the ball at this moment. The values of n, R, and K used in this thrust calculation are all determined in stationary water. Therefore, to maintain the consistency of n and R/K, we must consider the water flow as the reference frame. In other words, we first need to determine what the velocity w' of the ball in the water would be if the water were stationary at this moment. Then, based on the analysis in section 4, we can calculate the thrust on the ball by the force field when the water flow velocity is v.
As previously established, when the water transitions from a stationary state to a velocity of v in an instant, the velocity of the ball changes from x/n to x/n - v/n, resulting in a change of -v/n. Initially disregarding the impact of -v/n, we can easily express the relationship between w and w' as w = w' + v. Then, incorporating the effect of -v/n, we get w = w' + v - v/n. Thus, we have:

$$w' = w - v + v / n \tag{6.32}$$

w and w' both represent the velocity of the ball relative to the ground, and it is crucial to understand the distinction between them. w is the actual velocity of the ball in the

scenario where the water flow velocity is v, while w' is the calculated velocity of the ball assuming the water is stationary at that moment. Finally, we compute the relative velocity between the field velocity x and w':

$$x-(w-v+v/n) \tag{6.33}$$

Taking a further look from the perspective of the force field, at the instant when the water flow velocity changes to v, due to the constant relative velocity between the field and the ball, it is equivalent to the thrust exerted on the ball in the reference frame of water being the thrust exerted by a field with a velocity of x - v/n. Therefore, the relative velocity between the force field and the ball can be further expressed as:

$$x-v/n-(w-v) \tag{6.34}$$

The results of formulas (6.33) and (6.34) can be seen to be consistent. Finally, we obtain the mathematical expression for F(w):

$$F(w)=(x-(w-v+v/n))/x*dL_{\max}*R \tag{6.35}$$

R is assigned specific properties; it is the elasticity coefficient of the spring. F(w) propels the ball placed on the smooth horizontal track 2. A high-precision controller can measure the ball's movement speed w in real-time and calculate the magnitude of F(w) according to formula (6.34). The controller adjusts the extension of the spring by adjusting the movement speed of power rod A in real-time, enabling the spring to output the elastic force F(w) with relatively high precision.

The entire experimental setup involves only two forces: the thrust F(w) on the ball and the resistance f(w-v) exerted by the water on the ball. The resistance f(w-v) is proportional to the ball's moving speed (w-v). w-v is the speed of the ball with the water flow as the reference frame.

$$f(w-v)=(w-v)*K \tag{6.36}$$

Here, K is the coefficient of water resistance, assuming that the ball's movement in water follows Stokes' law, K can be considered constant and unchanging. The ball moves under the combined action of F(w) and f(w-v). After the ball's speed stabilizes, the ball's moving speed w is read. If w equals the result calculated in (6.23), then verification has been achieved. Multiple sets of data for w can be obtained by adjusting the water flow speed v, the maximum moving speed x of the dynamic rod, and other parameters.

It is important to note that when calculating the ball's speed using (6.23), we must first determine the value of n. n is calculated as x divided by the ball's speed w0 in stationary water, giving:

$$n = x / w_0 \tag{6.37}$$

We can also use computer simulations to calculate the speed of the ball under different test conditions. Assuming we know the mass m of the ball, the maximum moving speed x of the driving rod, the ball's speed w0 in stationary water, and the maximum compression length dLmax of the spring. This allows us to calculate the relationship between R and K, as in stationary water, the thrust on the ball is equal to the resistance from the water, F(w0) = f(w0 - 0), resulting in:

$$(x - w_0) / x * dL_{\max} * R = w_0 * K \tag{6.38}$$

Further assuming R=1, substituting into (6.38) we get:

$$K = (x - w_0) / x * dL_{\max} / w_0 \tag{6.39}$$

This way, we can simulate the motion of the ball by writing a computer program that integrates over the time domain. When the ball's speed no longer changes, the speed w of the ball is output. We present the simulation results from the computer in Table 1:

						Boll speed	
m	x	w0	dLmax	v	n	w(Simulation)	w2(Theoretical)
1	10	8	2048	1	1.25	8.36	8.36
2	25	15	2048	7	1.66667	19.48	19.48
12	125	55	2048	19	2.27273	70.3216	70.3216
5	77	23	2048	3	3.34783	25.7323	25.7323
19	77	9	2048	10	8.55556	18.8634	18.8634

Table 1: Computer Simulation Results (w) and Theoretical Results (w2) for Ball Speed

From Table 1, it can be observed that the results of the computer simulation align with those of the Fizeau experiment. This indicates that the derivation of particle propagation in the medium is correct, and this heuristic method can stimulate peer thinking, fostering further research.

6.7 Experimental Simulation Program

As the C++ program code is relatively simple, we will directly share it here:

/*

```
        m: Mass of the ball
        x: Maximum speed of the dynamic rod (force field speed)
        w0: Speed at which the ball maintains uniform linear motion in stationary water
        dLmax: Maximum compression of the spring
        v: Velocity of the water flow
        n: Ratio of x to w0
        w: Speed of the ball in computer simulation (Earth as the reference frame)
        w2: Theoretically calculated speed of the ball (Earth as the reference frame)
*/
#include <bits/stdc++.h>
using namespace std;
int main()
{
        double diff=100000,minDiff=0.000000000001;
        double dt=0.000001,w=0,a=0,F=0,f=0,n;
        double m,x,w0,dLmax,v,R=1,K,w2;
        cin>>m>>x>>w0>>dLmax>>v;
        n=x/w0;     cout<<"n="<<n<<endl;
        K=(x-w0)/x*dLmax/w0;
        while(1)
        {
                F=(x-(w-v+v/n))/x*dLmax*R; // Calculate the thrust force acting on the ball
                f=(w-v)*K; // Calculate the resistance force from the water acting on the ball
                a=(F-f)/m; // Calculate the acceleration at this moment
                w=w+a*dt; // Update the speed of the ball
                diff = fabs(a*dt); // Calculate the change in speed
                if(diff<minDiff) break; // End if the change in speed is negligible
        }
        w2=x/n+v-v/(n*n); // Calculated ball speed w2 theoretically
        cout<<"w="<<w<<" | "<<"w2="<<w2;
}
```

In this program, there is a detail that needs attention. w is the speed of the ball with the Earth as the reference frame. Why can't we directly calculate the relative speed between the force field and the ball as x−w? Namely, calculate F = (x - w) / x * dLmax * R to obtain F. If calculated in this way, it becomes a calculation with the Earth as the reference frame,

and the water flow is no longer "stationary." The variables n and the ratio between R and K would change because these variables are all calculated in stationary water. We must first switch to the reference frame of the water flow and calculate the thrust force using F = (x - (w - v + v/n)) / x * dLmax * R.

The C++ code, entirely based on this paper, effectively showcasing the differentiation details in the time domain and the accumulated results in the time domain. I hope that this program and my annotations on this program will help everyone's understanding. The Fizeau experiment is one of the greatest experiments in human history, and it is a crucial key to unlocking the mysteries of the universe. I hope that our research can inspire colleagues to think and promote further studies.

6.8 Summary of the Fizeau Experiment

The speed of light in a moving medium is determined by the combined effects of the Doppler effect caused by the relative speed between photons and the electric field, the Doppler effect caused by the relative speed between photons and the medium, and the intrinsic characteristics of the medium (refractive index, n). The relativistic formula for velocities addition demonstrates its validity when the speed of the medium relative to the speed of light can be neglected. The Fizeau experiment provides us with insights into the physical mechanisms of light propagation in a medium, making it a remarkable experiment. As I mentioned earlier, it is a very important key for humanity to unlock the mysteries of the universe. I hope that our research can stimulate peer thinking and discussions. Finally, we would like to pay tribute to great physicists such as Feynman and Einstein.

The Fizeau experiment has demonstrated the particulate nature of light. Does this particulate nature manifest itself in other phenomena of light, such as refraction and reflection? Before we start this topic, we need to take another look at a very important experiment, the "Sagnac Effect Experiment," which can be seen as another version of the Fizeau experiment. Because this chapter was added later, in order not to disrupt the original structure of the book, I have numbered this chapter as 6a.

Chapter 6a
Investigating the Sagnac Effect

The Sagnac experiment setup implemented through a fiber optic loop effectively integrates elements from both the Sagnac and Fizeau experiments. This study analyzes the Sagnac effect from the perspectives of optical path time difference and optical path frequency difference, summarizing their respective advantages and disadvantages. The method based on optical path time difference can neglect the influence of refractive index n, where the time difference depends on the closed-loop area and angular velocity ω of the optical path, hence unable to validate the Fizeau experiment of "measuring the speed of light in a moving medium." On the other hand, the approach based on optical path frequency difference does not need to consider the closed-loop area of the optical path. For a closed-loop path with radius R, the final result is unaffected by the size of R, and the optical path frequency difference is only related to the angular velocity ω and refractive index. Therefore, the optical path frequency difference method can verify the Fizeau experiment, demonstrating that when the speed of a moving medium cannot be neglected, the derivation of the Fizeau experiment based on the theory of special relativity is no longer approximately valid. The fiber optic interferometer experiment also provides an answer to the question of whether the "complete dragging of the ether theory" or Special Relativity is correct.

6a.1 Introduction to Sagnac effect

The Sagnac effect[35][36][37], also known as Sagnac interference, is named after the French physicist Georges Sagnac. It is a phenomenon in interference measurements caused by rotation. The Sagnac effect is manifested in a device called a ring interferometer or Sagnac interferometer. In this setup, a beam of light is split into two beams that propagate along the same path but in opposite directions. When they return to the point of entry, the two beams exit the loop and interfere. The relative phase of the two beams and the position of interference fringes both shift according to the angular velocity of the instrument. In other words, when the interferometer is at rest relative to a non-rotating frame, the time taken for light to pass through the loop in any direction is the same. However, when the interferometer system rotates, one beam of light needs to travel a longer path around the mechanical framework than the other beam, requiring more time

and resulting in a phase difference between the two beams.

Georges Sagnac initiated this experiment in 1913 in an attempt to prove the existence of the ether. The experiment aimed to determine whether there was a stationary ether, an ether partially dragged by the Earth, or an ether completely dragged by the Earth.

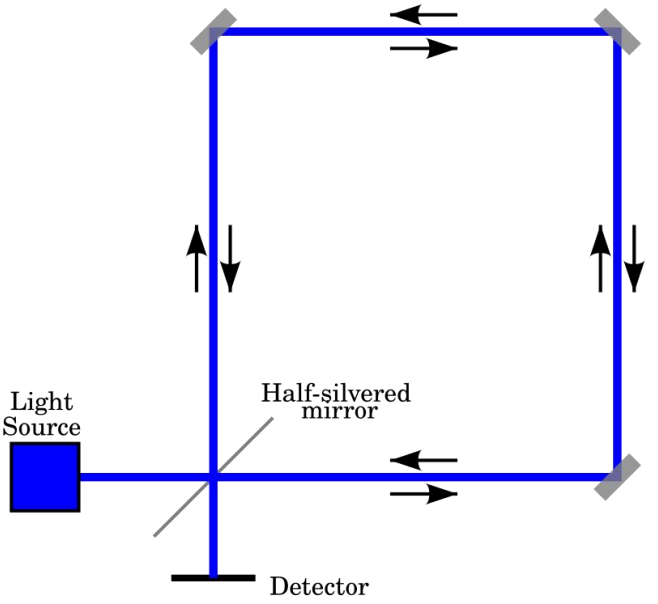


Figure 6a.1: Schematic diagram of the Sagnac interferometer.

Usually three or more mirrors are used so that the light beam propagating in the reverse direction follows a closed path, such as a triangle or square (see Figure 6a.1). Alternatively, optical fibers can be used to guide light through a closed path (see Figure 6a.2).

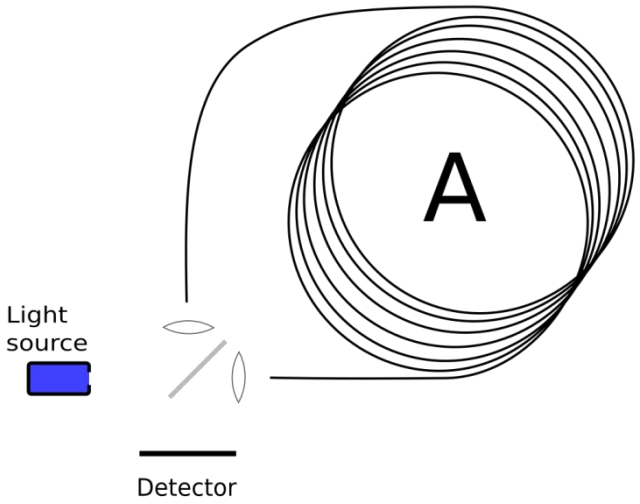


Figure 6a.2: Guided-wave Sagnac interferometer or fiber optic gyroscope can be implemented using single-loop or multi-loop optical fibers.

If the platform on which the ring interferometer is installed is rotating, the position of the interference fringes will shift compared to when the platform is stationary. The amount of shift is proportional to the angular velocity of the rotating platform. The rotation axis does not have to be located within the closed area. The phase shift of the interference fringes is proportional to the angular frequency ω of the platform, as given by the formula originally derived by Sagnac:

$$\Delta\phi \approx \frac{8\pi}{\lambda c}\omega \cdot A \qquad \text{(6a.1)}$$

A represents the oriented area of the loop, and λ is the wavelength of light. This effect arises because the time taken for the beams moving clockwise and counterclockwise to complete one round trip in the interferometer loop is different. The difference in travel times multiplied by the light frequency (c/λ) determines the phase difference $\Delta\phi$. Such measurements of rotation are absolute rotation, meaning the rotation of the platform relative to an inertial reference frame.

6a.2 Classic "Optical Path Time Difference" Analysis of Ring Interferometer

The displacement of interference fringes in a ring interferometer can be intuitively understood as resulting from the rotation of the loop causing different distances for light propagation (see Figure 6a.3).

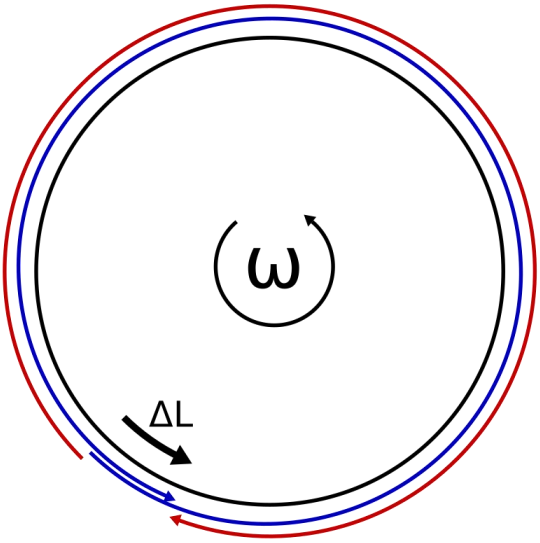


Figure 6a.3: Light propagating in opposite directions will travel different distances before reaching the moving light source.

The simplest derivation involves a circular ring with a radius of R, a refractive index of 1, and rotating at an angular velocity ω. However, the results are also applicable to ring geometries with other shapes. If a light source emits light in two directions from a point on the rotating ring, the light propagating in the same direction as the rotation needs to travel more than one full loop around the ring to catch up with the light coming from behind. The time t1 required for the light to catch up with the light source is:

$$t_1 = \frac{2\pi R + \Delta l}{c} \tag{6a.2}$$

Δl is the distance that the mirrors move in the same amount of time (as shown by the thick black arrows in Figure 6a.3):

$$\Delta l = \omega R t_1 \tag{6a.3}$$

Substituting (6a.3) into (6a.2), we obtain:

$$t_1 = \frac{2\pi R}{c - \omega R} \tag{6a.4}$$

Similarly, the light propagating in the opposite direction to the rotation will not complete a full loop before reaching the front-facing light source. Therefore, the time for the light in that direction to reach the moving light source again is:

$$t_2 = \frac{2\pi R}{c + \omega R} \tag{6a.5}$$

Time difference is:

$$\Delta t = t_1 - t_2 = \frac{4\pi R^2 \omega}{c^2 - \omega^2 R^2} \tag{6a.6}$$

Due to $\omega^2 R^2 \ll c^2$, simplifying (6a.6) yields:

$$\Delta t = t_1 - t_2 \approx \frac{4\pi R^2 \omega}{c^2} = \frac{4A\omega}{c^2} \tag{6a.7}$$

A represents the area of the loop. Next, calculate the distance Δs that light travels in time Δt.

$$\Delta s = c * \Delta t = \frac{4A\omega}{c} \tag{6a.8}$$

Next, calculate the number of interference fringe shifts.

$$num = \Delta s / \lambda = \frac{4A\omega}{c\lambda} \tag{6a.9}$$

By counting the number of fringe shifts, we can calculate the angular velocity ω.

$$\omega = \frac{num * c\lambda}{4A} \tag{6a.10}$$

For example, assuming the number of fringe shifts is 1, R = 1 m, and the wavelength of light is 500 nm, substituting into (6a.10) gives:

$$\omega = \frac{num * c\lambda}{4A} = \frac{1 * 3.0 * 10^8 * 500 * 10^{-9}}{4 * 3.14159 * 1^2} = 11.9 \text{ (}\textit{radians/s}\text{)} \tag{6a.11}$$

Although this simple derivation is for a circular ring with a refractive index of 1, the results apply to any rotating ring with an area of A, regardless of its shape. (See Figure 6a.4)

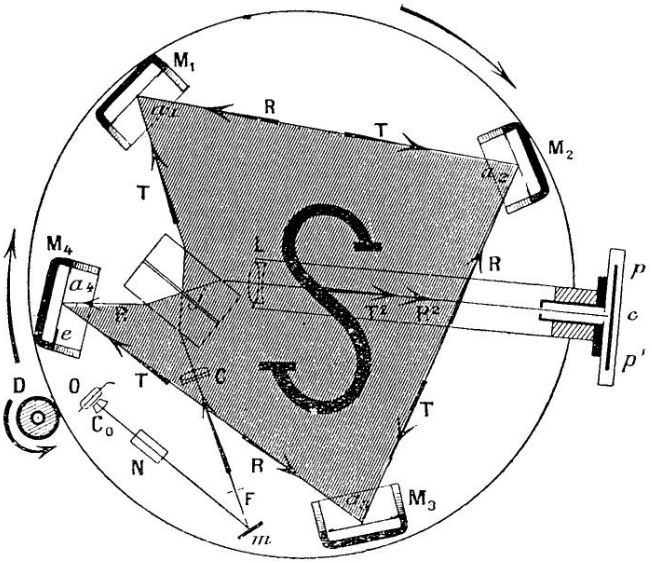


Figure 6a. 4. The Sagnac area formula applies to rings of any shape.

6a.3 "Optical Path Frequency Difference" Analysis in Ring Interferometer

Through (6a.4) and (6a.5), we can calculate the time it takes for light to complete a closed loop path on both paths. Therefore, we can easily calculate the frequency difference for light completing the closed loop path:

$$\Delta f = f_2 - f_1 = \frac{1}{t_2} - \frac{1}{t_1} = \frac{c+\omega R}{2\pi R} - \frac{c-\omega R}{2\pi R} = \frac{2\omega R}{2\pi R} = \frac{\omega}{\pi} \qquad (6a.12)$$

In other words, the optical path frequency difference can reflect the information about ω. Therefore, all we need to do is count the number of times N that light completes the closed loop path within a period of time T, and then calculate the optical path frequency through f = N/T. Counting N is very easy to achieve in practice. Thus, we obtain f1 = N1/T, f2 = N2/T, and then proceed to calculate the frequency difference:

$$\Delta f = f_2 - f_1 = (N_2 - N_1)/T = \frac{\omega}{\pi} \qquad (6a.13)$$

This way, we can obtain:

$$\omega = \Delta f * \pi \qquad (6a.14)$$

Clearly, this kind of analysis based on the optical path frequency domain difference makes it easier to calculate ω, and it does not involve approximations like (6a.7), making it also straightforward to implement in practice. It can be seen that (6a.14) is independent of the

closed-loop radius R, meaning that regardless of the size of R, the final results remain consistent.

6a.4 Analysis of Ring Interferometer with Refractive Index n

When light propagates through optical fiber cables, this setup is essentially a combination of the Sagnac experiment and the Fizeau experiment (as shown in Figure 6a.5). In glass, the speed of light is slower than in a vacuum, and the optical cable is the moving medium. In this scenario, the refractive index n > 1. The speed of light in the optical fiber needs to be calculated using the conclusions from the Fizeau experiment.

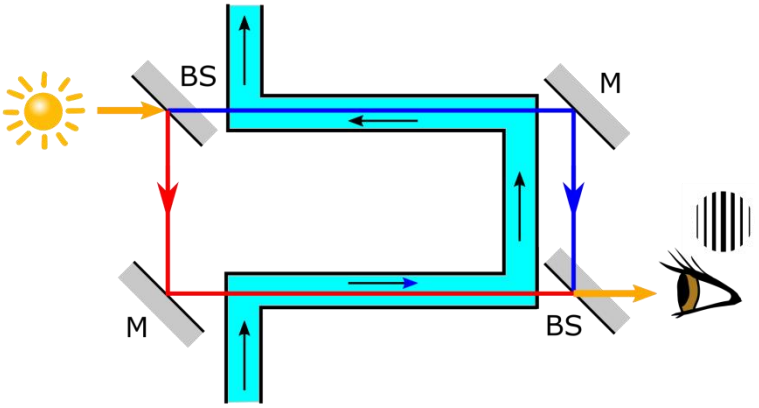


Figure 6a.5: Schematic Diagram of the Fizeau Experiment

Based on the conclusions of the Fizeau experiment , and substituting the linear velocity of the optical fiber v= ω R, we obtain:

$$w_+ = c/n + v(1-1/n^2) = c/n + \omega R(1-1/n^2)\,, \qquad \text{(6a.15)}$$

$$w_- = c/n - v(1-1/n^2) = c/n - \omega R(1-1/n^2)\,, \qquad \text{(6a.16)}$$

Substitute the speeds of light in two directions, w_+ and w_-, into (6a.4) and (6a.5) to get:

$$t_1 = \frac{2\pi R}{w_+ - \omega R} = \frac{2\pi R}{c/n - \omega R/n^2} \qquad \text{(6a.17)}$$

$$t_2 = \frac{2\pi R}{w_- + \omega R} = \frac{2\pi R}{c/n + \omega R/n^2} \qquad \text{(6a.18)}$$

Calculate the time difference:

$$\Delta t = t_1 - t_2 = \frac{4\pi R^2 \omega / n^2}{(c/n)^2 - (\omega R / n^2)^2} = \frac{4\pi R^2 \omega}{c^2 - (\omega R / n)^2} \approx \frac{4\pi R^2 \omega}{c^2} \quad \text{(6a.19)}$$

It can be seen that (6a.19) is consistent with (6a.7). This means that when ωR/n << c, the refractive index n does not affect the time difference, n is neglected. Next, let's examine the impact on the optical path frequency difference.

$$\Delta f = f_2 - f_1 = \frac{c/n + \omega R / n^2}{2\pi R} - \frac{c/n - \omega R / n^2}{2\pi R} = \frac{2\omega R / n^2}{2\pi R} = \frac{w}{\pi n^2} \quad \text{(6a.20)}$$

It can be observed that the frequency difference is influenced by n, we obtain:

$$\omega = \Delta f * \pi * n^2 \quad \text{(6a.21)}$$

Comparing to (6a.14), (6a.21) includes an additional factor of n^2, meaning that with the same frequency difference, a larger n will result in a greater angular velocity ω. Therefore, by knowing the frequency difference Δf and the refractive index n, we can calculate ω.

Similarly, if ω and Δf are known, we can inversely calculate the refractive index n' using (6a.21).

$$n' = \sqrt{\omega / \Delta f / \pi} \quad \text{(6a.22)}$$

Because (6a.21) is independent of the radius R of the closed loop, it implies that, regardless of the size of R, as long as ω is kept constant, Δf will not change. This leads us to speculate that when R is sufficiently large, even if the speed of the optical fiber $v = \omega R$ reaches 1/100th of the speed of light, it will not affect the final result. This is inconsistent with SR's argument for Fizeau experiment.

$$V_{lab} - \frac{c}{n} = \frac{\frac{c}{n} + v}{1 + \frac{v}{cn}} - \frac{c}{n} = \frac{v(1 - \frac{1}{n^2})}{1 + \frac{v}{cn}} \approx v(1 - \frac{1}{n^2}) \quad \text{(6a.23)}$$

Equation (6a.23) is derived from Special Relativity (SR) and represents the speed of light in a moving medium. For (6a.23) to hold true, the premise is that v << c. Obviously, when the

speed of the medium v = 1/100 * c, (6a.23) cannot be approximated as $v(1-\frac{1}{n^2})$.

Therefore, the Fizeau experiment argument based on SR can only be a mathematically limited approximation proof (v must be much smaller than c).

Based on the analysis of optical path time difference and optical path frequency difference, each has its own advantages and disadvantages. If the refractive index of the medium is greater than 1, according to the optical path time difference formula (6a.19), n will not affect the final result regardless of its value. Therefore, the advantage of (6a.19) is that there is no need to consider the refractive index n of the material, even if n changes continuously over time. However, this is also its drawback, as through (6a.19), we cannot verify the Fizeau experiment conclusions related to n. On the other hand, the optical path frequency difference formula (6a.20) reflects the influence of n. Hence, (6a.20) can be effectively used to verify the conclusions of the Fizeau experiment. By adjusting the angular velocity ω continuously and observing how Δf changes according to (6a.21), we can verify the conclusions of the Fizeau experiment.

Furthermore, since (6a.20) does not require consideration of the closed loop radius R, even if R is very large, allowing the optical fiber to achieve a very high speed v, it still cannot affect the result. This theoretically proves that when the medium's moving speed does not satisfy v << c, the proof of the Fizeau experiment based on Special Relativity is invalid. Some might ask if it's possible to design an experiment with an extremely large R to validate my analysis. What I want to emphasize is that such an experiment would be challenging to implement and entirely unnecessary; (6a.20) has already demonstrated that the argument based on Special Relativity is incorrect.

It can be said that the study of the Sagnac effect is inseparable from the study of the Fizeau experiment; they are closely intertwined.

6a.5 Design of Fiber Optic Interferometer Based on Optical Path Frequency Difference

According to (6a.20), we only need to separately count the number of times N that light completes the fiber optic loop and the total time T in order to calculate the frequency f.

$$f = N / T \tag{6a.24}$$

With the help of FPGA technology, we can easily achieve the counting of N and T. However, it is essential to consider the impact of errors, which are determined by the FPGA's CLOCK. When detecting the optical signal converted into electrical signals by the edge of the

CLOCK, if we only use the rising edge for detection, there may be a maximum time error of 1 CLOCK period. As shown in Figure 6a.6. If the preceding rising edge misses the signal, one must wait for the next clock cycle's rising edge.

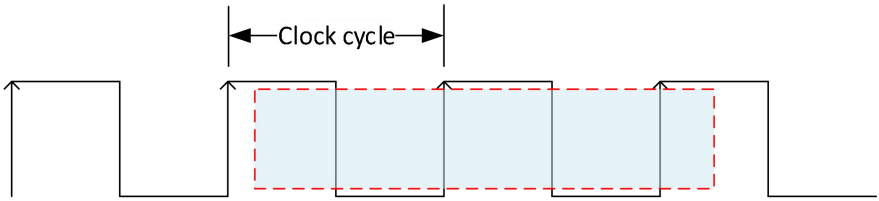


Figure 6a.6: Time error introduced by CLOCK rising edge detection.

The generation and reception of light are synchronized with CLOCK, so it can introduce a maximum time error of 1 CLOCK period every M transmit-receive cycles. Assuming N is divisible by M, the maximum time error can be calculated as:

$$\Delta T = N / M * clockcycle \tag{6a.25}$$

Correcting (6a.24) yields:

$$f_{\max} = \frac{N}{T} \tag{6a.26a}$$

$$f_{\min} = \frac{N}{T + \Delta T} = \frac{N}{T + N / M * clockcycle} \tag{6a.26b}$$

We will give two examples to illustrate the accuracy of the interferometer designed based on the principle of optical path frequency difference. The first example is the measurement over a long period (1s):

Assume: The length of the optical fiber is 1000m, CLOCK = 1GHz, i.e., clock cycle = 1ns, N = 10,000,000, M = 100, N/M = 100,000, the refractive index of the optical fiber n = 1.5. The times taken are T1 = 100s, T2 = 100.7801s. Calculate the frequency range of light in two directions using (6a.26a) and (6a.26b):

$$f_{1\max} = \frac{N}{T_1} \approx 100000.000000\text{Hz} \tag{6a.27a}$$

$$f_{1\min} = \frac{N}{T_1 + N / M * clockcycle} \approx 99999.900000\text{Hz} \tag{6a.27b}$$

$$f_{2\max} = \frac{N}{T_2} \approx 99225.938454\text{Hz} \tag{6a.28a}$$

$$f_{2\min} = \frac{N}{T_2 + N/M * clockcycle} \approx 99225.839996\text{Hz} \quad (6a.28b)$$

Calculate the range of the frequency difference:

$$\Delta f_{\max} = f_{1\max} - f_{2\min} = 774.160004\text{Hz} \quad (6a.29a)$$

$$\Delta f_{\min} = f_{1\min} - f_{2\max} = 773.961546\text{Hz} \quad (6a.29a)$$

The maximum error in the frequency difference is:

$$\Delta f_{\max} - \Delta f_{\min} = 774.160004\text{Hz} - 773.961546\text{Hz} = 0.198458\text{Hz} \quad (6a.30)$$

It can be seen that the error of the frequency difference is approximately 0.02564% of the true value. This is a trustworthy data. If we continue to decrease the ratio between N and M, the error will be even smaller. Next, we calculate the average value of the frequency difference to be 774.06Hz, and then calculate ω according to (6a.21).

$$\omega = \Delta f * \pi * n^2 \approx 774.06 * 360 * 1.5^2 = 626988.6\,°/\text{s}=174.16°/\text{s} \quad (6a.31)$$

By conducting measurements over a long period (100s), it can be observed that a relatively high precision value for ω can be obtained. Next, let's consider an example of measurements taken over a short period (1ms):

Assume: The approximate length of the optical fiber is 1000 meters, CLOCK = 1GHz, i.e., clock cycle = 1ns, N = 100, M = 100, the refractive index of the optical fiber n = 1.5. The times taken are T1 = 1ms, T2 = 1.28ms. Calculate the frequency range of light in two directions using (6a.26a) and (6a.26b):

$$f_{1\max} = \frac{N}{T_1} \approx 100000.000000\text{Hz} \quad (6a.32a)$$

$$f_{1\min} = \frac{N}{T_1 + N/M * clockcycle} \approx 99999.900000\text{Hz} \quad (6a.32b)$$

$$f_{2\max} = \frac{N}{T_2} \approx 78125.000000\text{Hz} \quad (6a.33a)$$

$$f_{2\min} = \frac{N}{T_2 + N/M * clockcycle} \approx 78124.938965\text{Hz} \quad (6a.33b)$$

Calculate the range of the frequency difference:

$$\Delta f_{\max} = f_{1\max} - f_{2\min} = 21875.061035\text{Hz} \quad \text{(6a.34a)}$$

$$\Delta f_{\min} = f_{1\min} - f_{2\max} = 21874.900000\text{Hz} \quad \text{(6a.34a)}$$

The maximum error in the frequency difference is:

$$\Delta f_{\max} - \Delta f_{\min} = 21875.061035\text{Hz} - 21874.900000\text{Hz} = 0.161035\,\text{Hz} \quad \text{(6a.35)}$$

It can be observed that the error of the frequency difference is approximately 0.00074% of the true value. This remains a trustworthy data. Next, we calculate the average value of the frequency difference to be 21874.98Hz, and then calculate ω according to (21).

$$\omega = \Delta f * \pi * n^2 \approx 21874.98 * 360 * 1.5^2 = 17718733.8\ ^\circ/\text{s} = 4921.87^\circ/\text{h} \quad \text{(6a.36)}$$

Designing a high-precision fiber optic interferometer based on the optical path length frequency difference principle is relatively easy to achieve. It can not only measure statistical averages over long periods but also capture dynamic values over short periods. However, it is influenced by the refractive index n, which is both an advantage - as it can be used to verify the Fizeau experiment - and a disadvantage, as the refractive index of fiber optic materials varies and undergoes slight changes, necessitating correction for the deviations caused by n values. Moreover, the CLOCK of the FPGA also needs to have a certain level of precision and stability. We have only provided theoretical analysis; creating a high-precision frequency difference interferometer requires consideration of various factors. Finally, I will share the C++ code used for the calculations below:

```
#include<iostream>
#include<cmath>
using namespace std;
int main()
{
    double c=3e8;//Speed of light (m/s)
    double len=1000;//Fiber length (m)
    double n=1.5;//Refractive index of the optical fiber
    double clockcycle=1e-9;//CLOCK 1GHz,1ns
    long long M=100;//Time for one measurement of M optical path lengths
    double T1,T2;//Total time for reverse and forward optical path (s)
```

```
    long long N;//N times optical path

    //T1=100,T2=100.7801;
    T1=1e-3,T2=1.28e-3;

    N=(c/n*T1/len)/2;//The theoretical maximum value of N is c/n*T1/len
    cout<<"M="<<M<<"    N="<<N<<"    (Note: N>=M and N%M==0)\n"<<endl;
    if(N<M || N%M!=0)
    {
        cout<<"Invalid N or M"<<endl; return 0;
    }
    double f1max,f1min,f2max,f2min,dfmax,dfmin,dfmean,ddfmax;
    f1max=N/T1; f1min=N/(T1+N/M*clockcycle);
    f2max=N/T2; f2min=N/(T2+N/M*clockcycle);
    dfmax=f1max-f2min;
    dfmin=f1min-f2max;
    dfmean=(dfmax+dfmin)/2.0;
    ddfmax=dfmax-dfmin;
    printf("f1max=%20.6fHz, f1min=%20.6fHz\n",f1max,f1min);
    printf("f2max=%20.6fHz, f2min=%20.6fHz\n",f2max,f2min);
    cout<<endl;
    printf("dfmax=%20.6fHz\ndfmin=%20.6fHz\n",dfmax,dfmin);
    printf("dfmean=%19.6fHz\n",dfmean);
    printf("ddfmax=%19.6fHz, percent:%.5f%%\n",ddfmax,100*ddfmax/dfmean);
    cout<<endl;
    double tmp=dfmean*360*n*n;
    printf("w= %.4f°/s = %.4f°/h",tmp,tmp/60/60);
}
```

6a.6 Measurement of Earth's Rotation Speed by the Sagnac Interferometer

We know that at different latitudes, the Earth's rotation speed calculated based on the Sagnac effect can be represented by the following formula:

$$Earth's\ rotation\ speed\ = 15°/s\ *\ sin\left(latitude\right) \qquad (6a.37)$$

where the latitude is the angular measurement of the location. For example, at the Equator, the Earth's rotation speed is 0, while at the North and South Poles, the Earth's

rotation speed is 15°/s. Data obtained from fiber optic gyroscopes align closely with theoretical calculations. We can also calculate that the equatorial rotational linear speed of the Earth is approximately

$$v = \omega R = \frac{15^\circ}{3600} * \frac{\pi}{180^\circ} * \frac{12,756km}{2} \approx 0.464km/s \quad (6a.38)$$

Returning to the beginning of the article, as shown in Figure 6a.1, we can construct a Sagnac interferometer with three mirrors, through which we can measure the Earth's rotation. This leads us to ponder further: can we build a Sagnac interferometer with only two mirrors? As shown in Figure 6a.8.

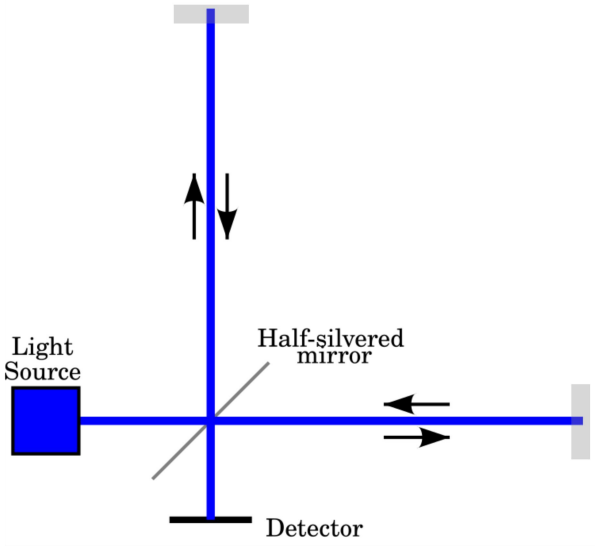


Figure 6a.8: Sagnac Interferometer with Two Mirrors

It can be seen that it is very similar to MMX. We know that MMX is performed in a relatively stationary environment with respect to the ground. No matter how the direction of the MMX experiment arm is adjusted, the movement of interference fringes cannot be observed. At that time, Michelson and Morley firmly believed that there was an ether around the Earth, and the ether was completely dragged by the Earth as light propagated through the ether as a medium. This "complete dragging ether theory" can well explain MMX, as long as the interferometer is stationary relative to the ground, and the direction of light is perpendicular to the mirror, that is, light has no velocity component parallel to the mirror, then the photon will reflect back vertically, with the ground or mirror as a

reference, the rotation speed of the photon is always 0. It can be imagined that if two parallel mirrors are placed stationary on the ground, and a photon is incident vertically on the mirror, then without considering the energy loss of the photon, the photon will be trapped in it by reflecting back and forth, as shown in Figure 6a.9.

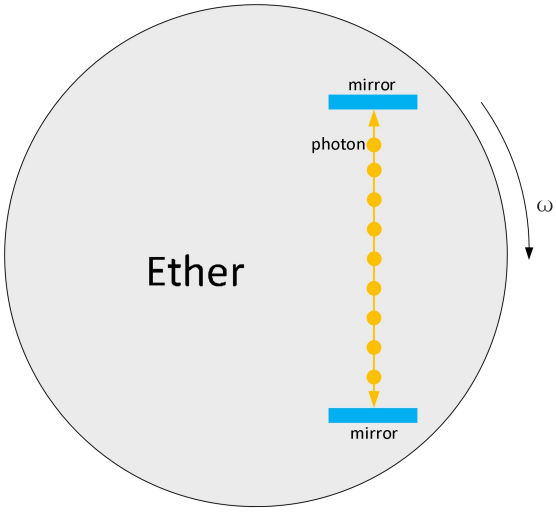


Figure 6a.9: Ether, photon, mirror, and ground rotating at the same angular velocity ω

However, if light is incident on the mirror at an inclined angle, then due to the presence of a velocity component v_2 parallel to the mirror, that is, tangential velocity, with the ground or mirror as a reference, the angular velocity of the photon along the path of light is no longer equal to 0. As shown in Figure 6a.10.

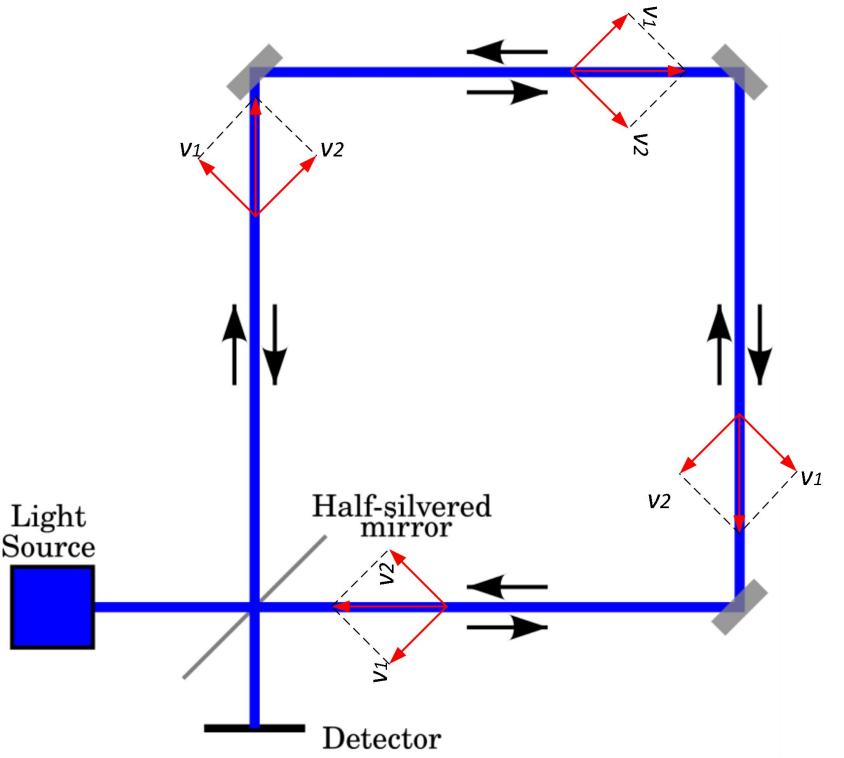


Figure 6a.10: Light incident on the mirror at an inclined angle

With the ground as a reference, let's designate the counterclockwise angular velocity of light as ω_{L+} and the clockwise angular velocity of light as ω_{L-}. According to the "complete dragging ether theory," the photon will superimpose the angular velocity of the ether, which is completely dragged by the Earth. Therefore, ω_{L+} and ω_{L-} are numerically equal, but their directions are opposite.

$$\omega_{L+} = \omega_{L-} = \omega_L \tag{6a.39}$$

Since the Earth's angular velocity is 0 with the ground as a reference, in order to study the effects of the Earth's angular velocity, we choose a point P directly above the interferometer, which is horizontally stationary on the ground, as a reference point (choosing the appropriate reference point is crucial for the analysis of physical problems).

Let's assume the Earth is rotating counterclockwise at an angular velocity of ω_{Earth} at this

moment. Thus, the counterclockwise angular velocity of light would be $\omega_L + \omega_{Earth}$, and the clockwise angular velocity of light would be $\omega_L - \omega_{Earth}$.

It can be seen that these velocities are not the same. Therefore, using point P as a reference, the time taken for the two light paths to complete one full revolution (2τ) will be different, namely:

$$t_1 = 2\pi / (\omega_L + \omega_{Earth}) \tag{6a.40}$$

$$t_2 = 2\pi / (\omega_L - \omega_{Earth}) \tag{6a.41}$$

The time difference is:

$$\Delta t = t_2 - t_1 = 2\pi/(\omega_L - \omega_{Earth}) - 2\pi/(\omega_L + \omega_{Earth}) = 4\pi\omega_{Earth}/(\omega_L^2 - \omega_{Earth}^2) \tag{6a.42}$$

When $\omega_L >> \omega_{Earth}$, simplifying, we get:

$$\Delta t \approx 4\pi\omega_{Earth} / \omega_L^2 \tag{6a.43}$$

For a circular light path with a radius of R, substituting $\omega_L = c/R$ into (6a.43), we obtain:

$$\Delta t = 4\pi R^2 \omega_{Earth} / c^2 \tag{6a.44}$$

As we can see, (6a.44) and (6a.7) are consistent. This is not surprising; they both use point P in space as the reference frame. One calculates time through "the angle of 2τ taken by light to complete a loop divided by the angular velocity of the photon along the light path," as shown in (6a.40) (6a.41), while the other calculates time through "the optical path traveled by light from the source and back to the source divided by the speed of light," as shown in (6a.4) (6a.5). Mathematically, they are equivalent. Similarly, through the analysis based on the principle of frequency difference, we can also arrive at the same conclusion.

Let's take another look at (6a.40) and (6a.41). If $\omega_L = 0$, which is the case in MMX, then t1 equals t2, the time difference is 0. In this scenario, we cannot measure the Earth's rotational angular velocity through MMX. In other words, the Earth's rotation has no effect

on the MMX; the interference fringes' movement cannot be observed in MMX. Therefore, the "complete dragging ether theory" not only explains the Sagnac effect very well but also provides a very good explanation for the MMX. It can also explain the stellar aberration very well.

So what if we make MMX no longer stationary relative to the ground, and make MMX rotate? In this way, even if the ether is completely dragged by the earth, the angular velocity of the ether will be inconsistent with that of MMX, so the angular velocity of the photon and the mirror will no longer be consistent, and the optical path will be affected by the angular velocity of the MMX's rotation, and the movement of the interference fringes can be observed. Furthermore, according to the "completely dragged ether theory", as long as the MMX is moved relative to the ground (whether it is uniform linear motion or non-uniform linear motion), the optical path difference on the two experimental arms will change. Similarly, if the ether is not completely dragged by the earth, MMX must be able to observe the movement of interference fringes. Therefore, the "partially dragged ether theory" must be wrong.

Let's make a simple summary: according to the "complete dragging ether theory," although the MMX cannot be used to detect the Earth's rotation, it can detect ether vibrations and ground vibrations. On the other hand, the Sagnac interferometer (with three or more mirrors) can be used to detect the Earth's rotational angular velocity. This is fundamentally because photons and the ether at the same position have different tangential velocities, leading to different angular velocities.

Therefore, for linear motion without tangential velocity, that is, motion with an angular velocity of 0, the Sagnac interferometer cannot detect it. It can be said that the Sagnac interferometer is used to detect whether the object being measured has a tangential velocity. On the other hand, the MMX is used to detect whether there is relative motion between the object being measured and the ether.

6a.7 Testing Special Relativity with the Sagnac Interferometer

Einstein also provided an explanation for the Michelson-Morley experiment (MMX). He believed that the speed of light is constant in any inertial reference frame; therefore, in the Earth's inertial reference frame, the MMX would not observe any movement of interference fringes.

Thus, there exist two opposing explanations for the MMX:

1. Light propagation requires the existence of an ether, and the ether is completely dragged by the Earth.

2. Light propagation does not require the existence of an ether; the speed of light is constant in any inertial reference frame.

Both explanations introduce assumptions (completely dragged ether and constant speed of light), and under these assumptions, both can reasonably explain MMX, so how to verify these two possibilities?

According to the previous analysis, we can keep MMX in a slow uniform linear motion state by moving it very slowly. If we can observe the movement of interference fringes, then Einstein's assumption that "the speed of light is constant in any inertial reference frame" is wrong, and vice versa, the correctness of Special Relativity can be verified. However, it is difficult for us to complete this experiment with the help of MMX. The equipment is too bulky and it is difficult to make it move at a uniform speed.

But the fiber interferometer has actually given the answer. Now place the fiber interferometer horizontally and still on the ground, as shown in Figure 6a.11.

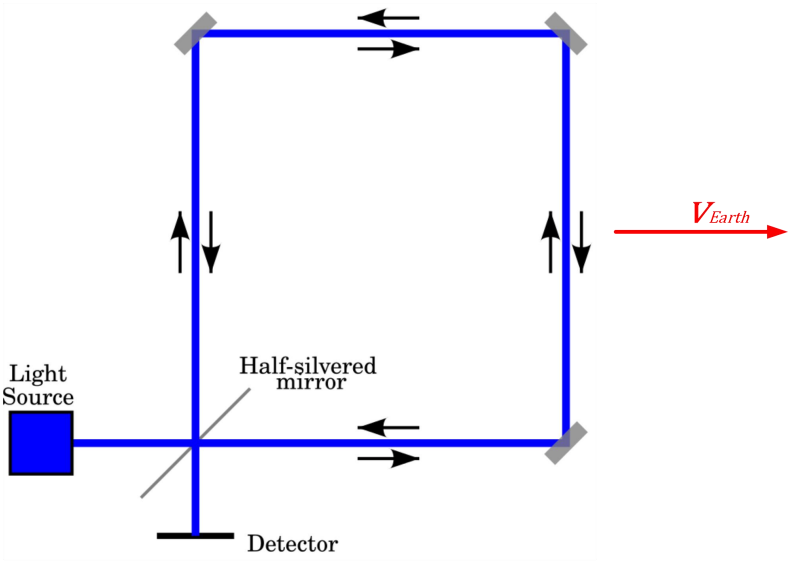


Figure 6a.11: Fiber optic interferometer placed horizontally stationary on the ground.

Using the Earth or a fiber optic interferometer as an inertial reference frame, according to Special Relativity's explanation of the MMX, "the speed of light remains constant in an inertial reference frame." Therefore, regardless of how fast or slow the Earth is moving, the time required for light to complete a round trip in two different directions is entirely consistent, and interference cannot occur. However, the fiber optic interferometer detects interference fringes and accurately reflects the tangential velocity of the Earth's rotation,

contradicting the conclusions of Special Relativity.

Thus, the fiber optic interferometer has effectively proven that Special Relativity is incorrect! Therefore, the true reason why the MMX experiment cannot observe the movement of interference fringes is that light propagation requires the existence of ether, and the ether is completely dragged by the Earth.
Special Relativity has been erroneously in existence for 100 years, starting from MMX and ending at Sagnac. Although this is difficult to accept, we must confront it.

6a.8 **Summary**

The Sagnac interferometer designed based on the principles of optical path time difference has been extensively utilized in various fields, with its accuracy beyond doubt. The method based on optical path frequency difference involves transitioning the analysis from the time domain to the frequency domain, akin to signal processing techniques commonly employed in wireless communications, aiding in unveiling crucial information concealed within the time domain.
Optical fiber interferometers designed through optical path frequency difference analysis can significantly simplify design and manufacturing complexities, thereby enhancing device precision more easily. Additionally, they provide an effective means for studying the Fizeau experiment. While it is challenging for us to experimentally refute the proof of the Fizeau experiment based on Special Relativity (SR), the analysis using the method of optical path frequency difference has theoretically demonstrated that when the speed of the moving medium cannot be ignored, the proof of SR regarding the Fizeau experiment is invalid. The correct proof of the Fizeau experiment has been provided [9].
The fiber optic interferometer has effectively proven that Special Relativity is incorrect! The propagation of light requires the ether, and the ether is completely dragged by the Earth. We hope that our research will bring new perspectives to our peers and actively promote the research and application of optical theories. Special thanks to scientists like Michelson, Morley, Sagnac, Fizeau, whose great contributions have propelled the progress of human science. Just as Newton said, "If I have seen further, it is by standing on the shoulders of giants." Those who love science, explore science will continue the work of their predecessors, and we are just a part of that group.

Chapter 7
Reflection and Refraction of Light

When light encounters an interface, part of the light is reflected back into the original medium. When light enters one medium from another, it refracts due to the difference in media, thus changing its direction. However, the phenomena of refraction and reflection are not unique to light. Similar phenomena occur in sound waves, mechanical waves, and even macroscopic particles. This seems to indicate that the physical mechanism behind these phenomena may be the same. Huygens-Fresnel's Principle explains the reflection and refraction of light, but this principle has some issues, such as insufficient explanations of the wave and particle nature of light. Light has become one of the most important tools for human scientific research, widely used in fields such as astrophysics and atomic structure. Therefore, in-depth research and understanding of the electromagnetic wave properties of light, as well as its reflection and refraction phenomena, are of great significance for the development of optical technologies and applications.

7.1 Huygens-Fresnel Principle

In 1678, Huygens proposed that every point reached by a disturbance of light becomes a source of spherical waves, and the superposition of these secondary waves determines the form of the wave at subsequent times. He assumed that the secondary waves only propagate in the "forward" direction, but the theory did not explain why it happens that way. He was able to qualitatively explain the propagation of linear and spherical waves and derived the laws of reflection and refraction using this principle, but he could not explain the phenomenon of diffraction. See Figure 7.1.

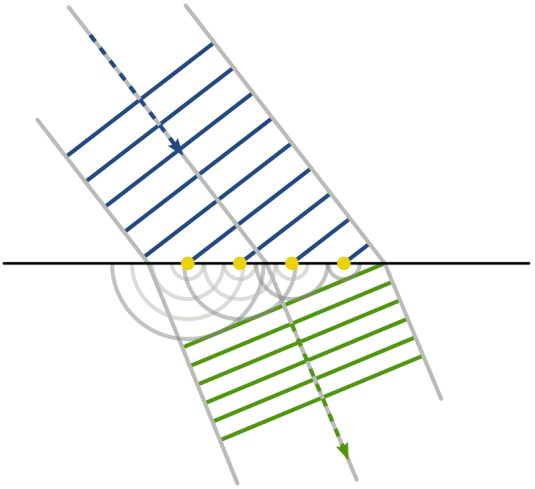


Figure 7.1: Huygens' wavefront refraction.

In 1818, Fresnel demonstrated that the Huygens' principle and his own interference principle could explain the straight propagation of light and the phenomenon of diffraction. See Figure 7.2. In order to obtain agreement with experimental results, he had to introduce additional arbitrary assumptions regarding the phase and amplitude of the secondary waves, as well as a tilting factor. These assumptions lacked a clear physical basis, but the predictions derived from them were consistent with numerous experimental observations.

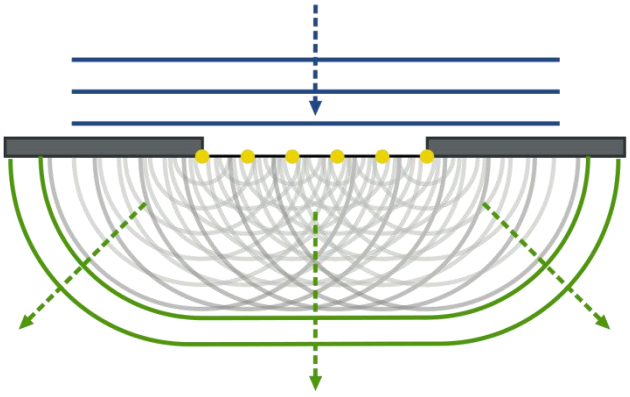


Figure 7.2: Wave diffraction according to Huygens and Fresnel's principles.

According to the Huygens-Fresnel principle, although one can accurately calculate the angles of refraction and reflection of light, the explanation for the physical processes

involved is unclear, and the introduced assumptions lack a clear physical basis. According to this principle, as shown in Figure 7.3, each point reached by a disturbance of light becomes a source of spherical waves. When multiple spherical waves are arranged in a straight line, according to spherical symmetry, these spherical waves form multiple wavefronts, resulting in multiple reflected and refracted light rays. This contradicts the fact that there is only one reflected and refracted light ray. The wavefronts formed in other directions cannot be canceled out by the superposition of waves.

(a) Front view (b) Side view

Figure 7.3: Spherical waves form multiple wavefronts.

Indeed, the viewpoint that "the Huygens' principle is an accurate microscopic description of reality" has not received unanimous support among all physicists. For example, Melvin Schwartz believed that "the Huygens' principle does indeed give the correct answer, but for the wrong reason." In light of this, can we search for more reasonable clues from the electromagnetic wave properties of light and the wave-particle duality of light?

7.2 Wave-Particle Duality of Light

While we have already discussed the wave-particle duality of light in the analysis of the Fizeau experiment [24], it is important to reiterate here that light exhibits both wave-like and particle-like properties. As a wave, light can propagate and demonstrate wave phenomena such as interference and diffraction, possessing wave characteristics like wavelength, frequency, and amplitude. However, as a particle, known as a photon, it is a quantum of light energy that possesses discrete energy and momentum. Experimental evidence such as the photoelectric effect and Compton scattering confirms the particle-like nature of light. Moving forward, we will explore the refraction and reflection of light through the lens of its particle-like properties.

7.3 Factors Influencing Particle Energy Transfer

Let's first investigate the propagation of energy in media. For instance, sound travels much slower in air than it does in water. What causes this difference in speed? There are several main factors that influence the transfer of energy between particles in a medium: the distance between particles, their elastic properties, and the tension between them. These

factors are not isolated; they can interact with each other and jointly affect the process of energy transfer. Therefore, the speed of energy transfer in a real system may be the result of a combination of multiple factors. We can refer to all factors that hinder the propagation of light energy as "medium resistance." In our analysis of the Fizeau experiment, we used the concept of medium resistance. Next, we will analyze each of the main factors that constitute medium resistance separately.

7.3.1 Distance between Particles

In physics, the transfer of energy through collisions between particles typically occurs at a faster speed than the individual particle's movement. When two particles collide, energy can be transferred through their interaction. During the moment of collision, energy is transferred to the other particle in the form of charge interaction or other types of interactions. This energy transfer process can be extremely fast and often occurs at the speed of light. In contrast, the movement speed of particles is limited by their mass and dynamic characteristics. The movement speed of particles can be relatively slow, depending on factors such as mass, applied forces, and damping. Therefore, the greater the distance between particles, the slower the average speed of energy transfer. The spacing between air molecules, for example, is approximately ten times larger than the spacing between liquid water molecules. Air molecules take more time to move through these "larger" distances, resulting in a slower average speed of energy transfer.

However, if the particle's movement speed approaches or exceeds the speed at which energy is transferred through collisions, then the distance between particles is no longer the primary factor affecting energy transfer. In another scenario, particles can transfer energy to each other through a medium, such as two balls connected by a rod. In this case, the balls do not need to collide directly to transfer energy; the speed of energy transfer is determined by the speed at which the rod's molecules collide and transfer energy. Similarly, particles can transfer energy through a field, such as the magnetic field between two magnets. Although the magnets do not directly collide, they transmit energy through the magnetic field, making the speed of the field crucial.

Therefore, for cases where energy transfer relies on direct collisions between particles, and the particle movement speed is relatively slow, the distance between particles becomes the main factor affecting energy transfer speed. Conversely, if the particle's movement speed is relatively fast, then distance is no longer the primary factor.

For cases where energy transfer does not require direct collisions between particles, the speed at which the "bridge" (a medium or a field) transfers energy between particles becomes the primary factor. In essence, this still involves collisions between particles, but it utilizes the collisions of other particles (or fields) to facilitate energy transfer. We can refer to this as indirect collisions, which are essentially the same as direct collisions. Therefore, we can generalize it as collisions between particles.

7.3.2 Elastic properties of particles

The elastic properties of particles can influence the speed of energy transfer. Elasticity refers to the property of an object to return to its original shape and size after being subjected to a force. In elastic collisions, the interaction forces between particles result in the transfer of energy. If particles have high elasticity, meaning that energy is completely transferred without any loss after a collision, then the speed of energy transfer can be very fast. In this case, energy is rapidly transferred to the other particle, and the entire process occurs almost instantaneously. However, if particles have lower elasticity or if there is energy loss during the collision process, the speed of energy transfer may be affected. In partially elastic collisions, some energy may be converted into other forms, such as heat, rather than being fully transferred to the other particle. In such cases, the speed of energy transfer is slowed down, and it may take some time for the energy distribution after the collision to reach equilibrium. Therefore, the elasticity of particles can impact the speed of energy transfer. Highly elastic particles are capable of transferring energy at a faster rate, while particles with lower elasticity may result in a slower speed of energy transfer and energy loss. For air molecules and water molecules, although they have some differences in their elasticity properties, the speed at which energy is transferred through collisions between particles is usually much faster than the movement speed of the particles themselves. Therefore, the difference in elastic properties can be negligible for energy transfer in mediums such as air and liquid water.

7.3.3 Tension between particles

The tension between particles refers to the internal forces acting on an object when it is stretched or under tension. It is a pulling force transmitted along the length of the object. The tension between particles contributes to the overall elasticity of the medium, but at the same time, it hinders the movement of particles. When tension is present, it exerts an interactive force that pulls or stretches the particles, thereby restricting their free movement. Tension acts between particles within the object, maintaining its structural integrity through mutual traction. If the tension is too strong or the object is excessively

stretched, the interactions between particles intensify, making it difficult for the particles to move. For example, when a rope is subjected to high tension, the interaction forces between the particles inside the rope increase, impeding the free movement of particles within the rope.

The tension between air particles is much smaller than the tension between water molecules, resulting in greater resistance to the movement of water molecules caused by tension.

If the distance between particles is not the primary factor affecting the speed of energy transfer, the resistance caused by the tension between particles becomes more prominent. Under the influence of resistance, the velocity of particles decreases.

7.3.4 Results of the Combined Influence of Multiple Factors

Under the combined influence of factors such as the distance between particles, the elastic properties of particles, and the tension between particles, the speed of energy transfer in liquid water is generally faster than in air, such as in the case of sound waves. However, if the distance between particles is not the primary factor, the elastic properties of particles and the resistance caused by tension between particles become the main factors. In this scenario, since the tension between air particles is smaller, resulting in less resistance to the movement of air particles, the speed of energy transfer in air would be faster compared to water.

7.4 Particle Reflection and Refraction

When moving particles encounter the interface between media, due to collisions between particles, some particles undergo reflection, where the angle of incidence is equal to the angle of reflection, according to the laws of conservation of kinetic energy and momentum. At the same time, some particles cross the interface and collide with the particles below. Let's consider the example of a particle entering water from air, with a velocity v1 perpendicular to AB in air and a velocity v2 perpendicular to AB in water. The particle and AB are initially perpendicular before the particle reaches the liquid surface. In the case of a particle entering water from air, as shown in Figure 7.4, the particle can be considered rigid. Therefore, as long as v1 and v2 are not equal, the particle will undergo deviation, and the magnitude and direction of v1 and v2 will change accordingly until v1 = v2, at which point the particle stops deviating, and its velocity no longer changes.

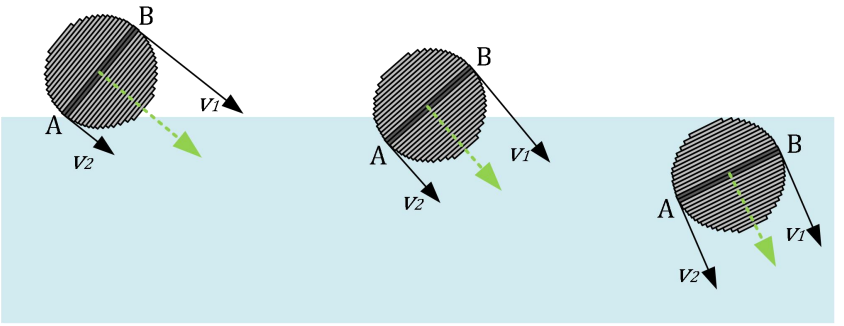


Figure 7.4: Particle Velocity Changes as it Crosses the Interface between Media.

As the bottom part of the particle enters the water first, it experiences resistance from the water, causing the velocity below the interface to be smaller than above the interface. This results in the particle tilting towards the right, with v2 gradually increasing and v1 gradually decreasing, altering the direction of the particle's velocity. This change continues until v1 = v2, at which point the particle is fully submerged in water. When multiple particles are arranged in a straight line and cross the interface at the same velocity, as shown in Figure 7.5, it can be observed that the particles become sparser, and the energy per unit area of the particles decreases. Next, we will use the model below to calculate the relationship between the deflection angle and the velocity of the particles.

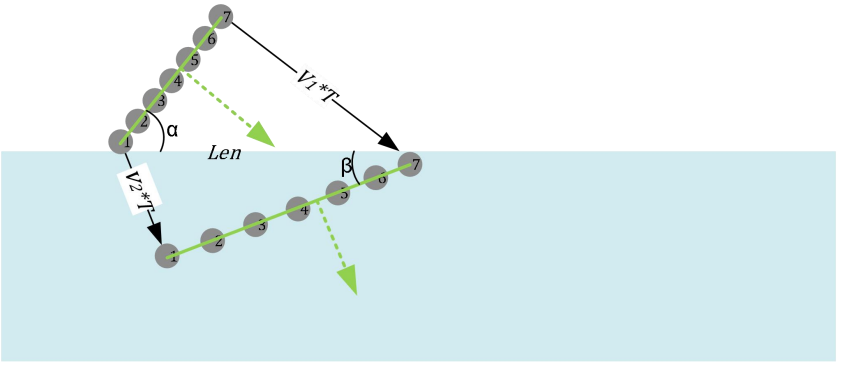


Figure 7.5: Model for Calculating the Deflection Angle of Particles Entering Different Media.

According to plane geometry:

$$v1 * T = Len * \sin\alpha \tag{7.1}$$

$$v2 * T = Len * \sin\beta \tag{7.2}$$

(7.1)/(7.2) yields:

$$\frac{v1}{v2} = \frac{\sin\alpha}{\sin\beta} \tag{7.3}$$

Here, Len represents the length of the interface between media, and T is the time taken for the particle to move. (7.3) shows that the deflection pattern of particles in different media follows the same rule as the law of refraction for light. So, does the reflection and refraction of light, which also exhibits particle-like behavior, have the same underlying physical mechanism?

7.5 Propagation of Light in Xton Medium

In the Fizeau experiment, we have proposed that the propagation of the electric field relies on some unknown substance that exhibits particle characteristics. For the purpose of analysis, we refer to this unknown medium particle as xton. Let's assume that the universe is filled with extremely tiny xtons, whose diameters are far smaller than electrons. Xtons achieve energy transfer through direct or indirect collisions, and the speed of energy transfer is equal to the speed of light. They possess excellent elastic properties, meaning they can effectively transfer energy. Now, let's analyze how the three factors—the distance between xtons, the elastic properties of xtons, and the tension between xtons—influence the speed of energy transfer.

7.5.1 Effect of Distance between Xtons on the Transmission Speed of Electric Field Energy

Since xtons are extremely small, the time required for direct collisions between xtons (or the displacement in the case of non-direct collisions) can be almost negligible. Therefore, the longitudinal energy transfer speed of xtons determines the speed of energy transfer of the electric field. When not constrained by external forces, the longitudinal energy transfer speed of xtons is equal to the speed of light. Therefore, the distance between xtons does not affect the speed of energy transfer of the electric field. (In the following Chapter 8, we will learn that light propagates in the form of xton vortices, and the longitudinal energy transfer speed of xton vortices determines the speed of light).

7.5.2 Effect of Xton's Elastic Properties on the Transmission Speed of Electric Field Energy

Since xton possesses excellent elastic properties, it can transfer all its kinetic energy to the next particle during a collision. Therefore, the elastic properties of xton do not affect the transmission speed of electric field energy.

7.5.3 Effect of Tension between Xtons on the Transmission Speed of Electric Field Energy

We know that there exist intermolecular forces between atoms [25], which result from the attraction between positively charged protons and negatively charged electrons, as well as the repulsion between electrons and protons. Essentially, these are the outcomes of electric field interactions. The greater the intermolecular force, the closer the two atoms are pulled together, and the electric field intensity between them also increases. To illustrate this, imagine the electric field as a horizontally placed spring, and the atoms as small balls fixed at both ends of the spring. If there is no attraction between the two balls, the spring will be at its natural length. However, if they attract each other, the spring will be compressed, increasing its elastic potential energy, and the entire system will return to a state of equilibrium. For atoms, both repulsion and attraction are provided by the electric field. As the distance between atoms decreases, the energy density of the electric field between them increases, making the electric field resemble a "tightened" net. In this case, the tension between the xtons that construct this energy net will increase, making it more difficult to move the xtons. Therefore, the tension between xtons has a significant impact on the transmission speed of electric field energy.

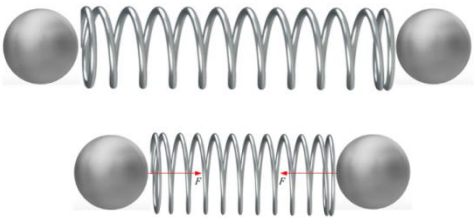


Figure 7.6: Spring in a Free, Extended State and Compressed Spring

To push the "trapped" xton, a greater force is needed to drive its movement. The electric field is "compressed," thus providing an "electric field elastic force" to counter the restraint of the electric field in the medium. As illustrated in Figure 7.7:

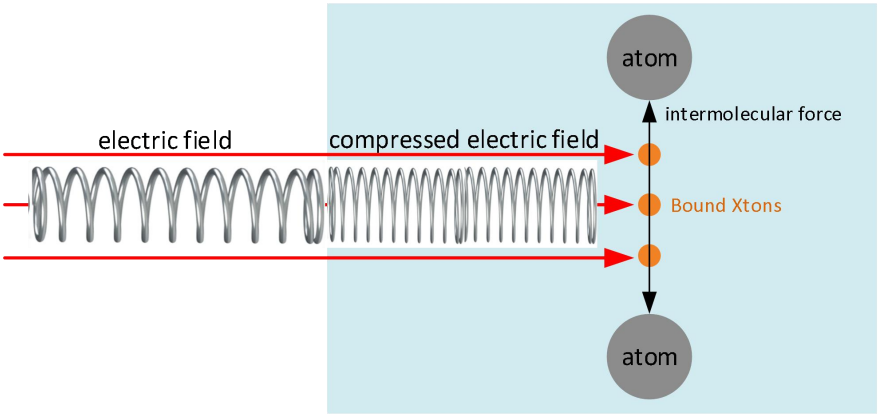


Figure 7.7: The Electric Field Provides an Electric Field Elastic Force Through Compression to Propel the Bound Xton

If the effect of gravity on air molecules is disregarded, in the air, due to the large spacing between air molecules, the electric field is hardly "tightened," so the resistance caused by the tension between xtons in the air can be neglected. Therefore, the speed of xtons transmitting electric field energy is approximately equal to the speed in a vacuum.

In liquid water, however, due to the small spacing between water molecules, the electric field is "tightened." Therefore, in water, the resistance caused by the tension between xtons cannot be ignored, and the speed of xtons transmitting electric field energy will decrease. In fact, the speed of light in liquid water is only 3/4 of its speed in a vacuum.

7.6 Xton's Direction of Light Reflection and Refraction

Due to collisions between xtons, they rebound, leading to the phenomenon of light reflection. When xtons cross an interface, as we already know, the tension between xtons is greater in water, resulting in greater resistance to their movement and a slower speed of energy transmission. Conversely, the speed approaches the speed of light in a vacuum, c. Therefore, when light enters water from air, the center of gravity of the xtons tilts towards the water surface, causing a decrease in speed and a deflection in the direction of travel. This results in the refraction angle being smaller than the incident angle.

In the Fizeau experiment, we demonstrated the process of a photon achieving equilibrium under the combined action of electric field force and medium resistance while traveling through a moving medium. When the medium is no longer stationary, the speed of light in the medium will also change. Therefore, the phenomena of light reflection and refraction

in a moving medium must differ from those observed in a stationary medium. **For example**, we can conduct optical experiments on a train moving at a constant speed, and you will observe different phenomena.

7.7 Summary of Light Reflection and Refraction

By introducing the hypothetical particle xton as the medium for electromagnetic wave energy transmission, we have been able to rationally explain the phenomena of light reflection and refraction using the particle nature of light. While we do not know the exact nature of xton, the particle nature of light clearly indicates its existence. The unique properties of the microscopic world mean that observing microscopic particles can influence their behavior, and measuring their properties can be challenging. These factors limit our understanding of the microscopic world. However, fortunately, light serves as a window for humans to peer into the microscopic world, offering us an opportunity to gain deeper insights into it.

Experiments on light reflection and refraction, as well as the Fizeau experiment studying the speed of light in moving media, have all revealed the existence of xton particles. Could it be possible that the electric field transmits energy through xtons, and the magnetic field accompanying changes in the electric field is also a manifestation of xtons' energy? Next, we will delve into the study of electric and magnetic fields.

We are now embarking on a journey into the microscopic world of light.

Chapter 8
Electric and Magnetic Fields

Electric and magnetic fields are two important concepts in physics. An electric field is a force field generated by charges, describing the force exerted by a charge on other charges or objects. The strength and direction of an electric field are represented by electric field lines, and the sign of the charge determines the direction of the electric field lines. A magnetic field, on the other hand, is a force field generated by magnetic charges or electric currents, describing the force exerted by a magnetic charge on other magnetic charges or objects. The strength and direction of a magnetic field are represented by magnetic field lines, and the north and south poles of a magnetic charge determine the direction of the magnetic field lines. Electric and magnetic fields have interacting properties, and their interaction forms an electromagnetic field, which is the foundation of electromagnetism. The theories of electric and magnetic fields have been widely applied.

The study of light has allowed us to observe the particulate nature of the electromagnetic field. Next, we will analyze how electric and magnetic fields transmit energy through xtons.

8.1 Energy Transmission in Electric and Magnetic Fields through xtons

So, how is the magnetic field, which is another component of the electromagnetic field, generated? And what role does it play in the energy transmission process of light? Classical physics tells us that a magnetic field is generated around a changing electric field. But what is the underlying physical mechanism? The answer may still lie in the particulate nature of light.

Experiments on light reflection and refraction, as well as the Fizeau experiment studying the speed of light in moving media, have all revealed the existence of xton particles [26][27]. Could it be possible that the electric field transmits energy through xtons, and the magnetic field accompanying changes in the electric field is also a manifestation of xtons' energy? Next, we will first delve into how the electric field transmits energy through xtons.

8.2 Generation of a Magnetic Field by a Changing Electric Field

According to classical physics, a stable electric field does not generate a magnetic field; only a changing electric field produces a magnetic field. Similarly, xtons propelled by an electric field exhibit a similar pattern: When the electric field is stable, the force exerted by the electric field on the xtons and the resistance force created by the tension between xtons form a balanced pair, keeping the xtons in a stationary state, as shown in Figure 8.1. However, when the electric field intensity changes, this balance is disrupted, and the xtons begin to move. In other words, xtons only move when the electric field changes, and the magnetic field emerges precisely when the electric field is varying. Therefore, there is likely a close relationship between the phenomenon of magnetic fields and the movement of xtons.

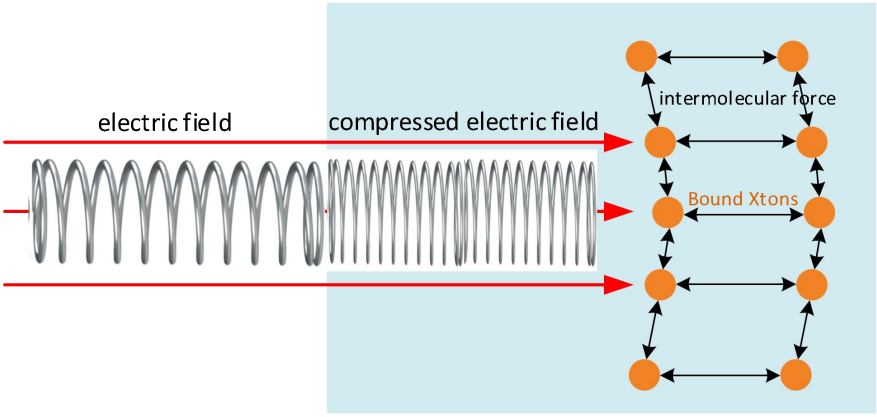


Figure 8.1: The resistance force created by the tension between xtons and the electric field force acting on the xtons form a balanced pair.

In a vacuum, the speed of light is equal to c, which means that the longitudinal energy transmission speed of xtons in a vacuum is faster than that in water. The greater the tension between particles, the greater the resistance, and the shorter the distance that xtons transmit longitudinal energy in the same amount of time. As a result, the electric field is compressed more severely, and its speed decreases. This resistance effect is quite significant, as evidenced by the Fizeau experiment [2]. As shown in Figure 8.1, we use the compression of a spring to represent the compression of the electric field, which is quite apparent. For example, the wavelength of light in water is compressed by 1/4.

In our analysis of the Fizeau experiment, or in the article "Fizeau Experiment: Investigating the Speed of Light in Moving Media" [27], it has been demonstrated that the tension between xtons in water is significantly influenced by the electric forces between atoms. In

a vacuum, the surrounding electric forces are extremely small (negligible). Therefore, in a vacuum, without considering the influence of gravitational fields, the longitudinal energy transmission speed of xtons propelled by the electric field is maximized, equivalent to the speed of light in a vacuum, which is c. However, in air or water, the electric forces between atoms increase the tension between xtons, resulting in a slower longitudinal energy transmission speed of xtons.

Gravity also has a certain impact on the tension between xtons. In a weak gravitational field, the tension between xtons caused by electric forces will be greater than that caused by gravity. However, in environments with exceptionally strong gravitational fields, the gravitational field becomes the primary factor affecting the tension between xtons. It can be predicted that the speed of light will become extremely slow near a black hole.

The above discussion has established how the energy of an electric field is transmitted longitudinally through xtons. But does xton possess transverse energy in addition to its longitudinal energy? In other words, xton not only transmits energy longitudinally but also transversely, moving forward in a spiral manner.

Why do we have such a conjecture? It is because the magnetic field that accompanies the changing electric field is transverse, which brings the concept of "spiral" energy transmission to our attention.

We know that stirring the surface of water in a spiral motion creates vortices, where energy is transmitted not only longitudinally but also transversely. Similarly, when xtons are stirred in a spiral motion, they form xton vortices, and energy is transmitted not only longitudinally but also laterally in the form of xton circulation, spreading out in all directions. This resembles a "vortex spring," as shown in Figure 8.2.

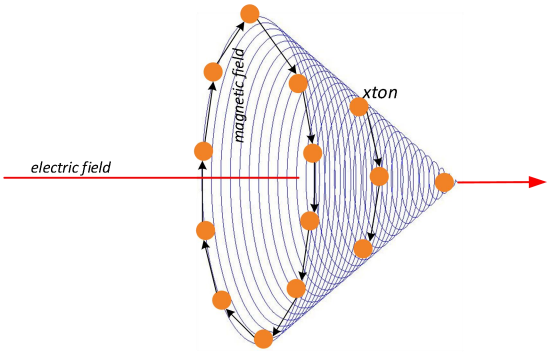


Figure 8.2: Xton Vortex

If xtons are only stirred in a spiral motion once, then for each point on the longitudinal path, there will be only one xton circulation centered on that point's vertical plane, and it will continue to expand, forming a conical shape similar to Figure 6. Conversely, if xtons are continuously stirred in a spiral motion, there will be countless xton circulations extending from the center outwards. This means that both longitudinal and transverse energy will be continuously transmitted. However, it is important to clarify that although the xton rings continue to expand, the xtons themselves do not continuously move. The xton rings are merely energy transmission loops. If the energy used for continuous stirring is stable, xton movement will only occur at the front edge. As shown in Figure 8.3, we use F1 to represent the force that propels the xtons, and F2 to represent the resistance force created by the tension.

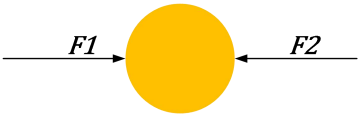


Figure 8.3: Thrust F1 acting on xton and resistance F2 formed by tension.

When the thrust F1 is greater than the resistance F2, the xton will move forward; if F1 is less than F2, the xton will move backward; and when F1 equals F2, the xton will stop moving. The xton ring is somewhat similar to a watch spring, as shown in Figure 8.4. The watch spring stores energy through rotation. When the external force applied decreases, the potential energy in the spring begins to release, and the spring unwinds. Conversely, when the external force increases, the spring tightens, and its potential energy increases. When the external force is equal to the spring's elastic force, the spring stops moving.

Figure 8.4: Watch Spring

We can also use a spring to describe this process. When a ball compresses a spring after

being subjected to a force, the spring shortens. Once the applied pressure and elastic force reach equilibrium, the spring no longer shortens. After this equilibrium is achieved, the ball and spring will not move as long as the external pressure remains unchanged, but this does not affect the transmission of energy through the compressed spring, as shown in Figure 8.5.

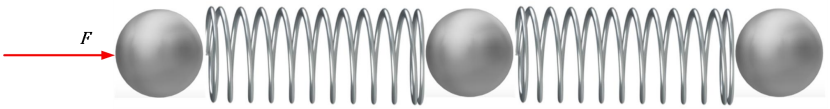


Figure 8.5: Energy Transmission Through a Compressed Spring

Therefore, stable and continuous spiral stirring of xtons will enable energy to be transmitted continuously and stably in both longitudinal and transverse directions. Once the energy that stirs the xtons changes, either increasing or decreasing, the balance of the xton rings is disrupted, and the xtons will start to move again until a new balance is achieved.

There is no magnetic field around a stable electric field, but a changing electric field can induce a magnetic field. This aligns with the behavior exhibited by xtons during energy transmission in the form of xton vortices. In other words, the xton vortex model can provide a good explanation of the relationship between electric fields and magnetic fields. In the following, we will use the xton vortex model to explain electric fields, magnetic fields, and electric charges.

8.3 What is an Electric Field?

We have already understood that the energy of an electric field is transmitted through xtons. Then, is the energy of an electric field equivalent to the longitudinal energy of an xton vortex? In other words, could an electric field be represented as the longitudinal movement of an xton vortex? According to classical physics, a charge emits an electric field in all directions around it, so there would be xton vortices in every direction of the charge. These vortices increase the tension between xtons in the surrounding area, causing a force acting against the charge. If the vortex energy is uniform in all directions, the charge will not move radially. However, if the xton vortex resistance in a particular direction of the charge decreases, the balance of forces acting on the charge will be disrupted, causing the charge to move in that direction. Conversely, the charge will move in the opposite direction. As illustrated in Figure 8.6:

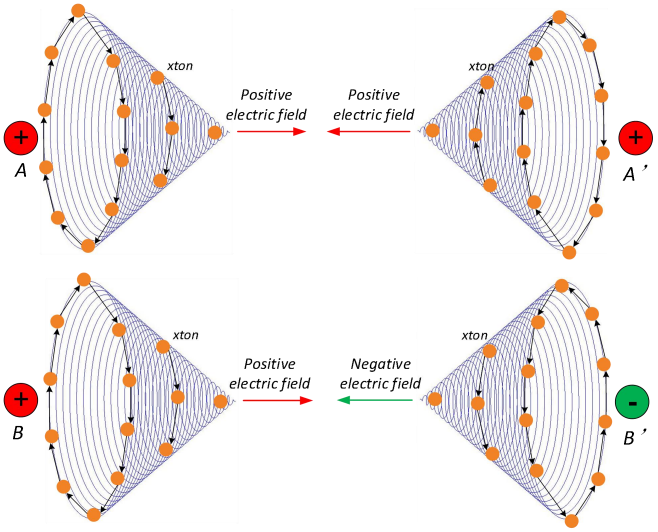


Figure 8.6: Forces Between Xton Vortices

If there is only a single charge in space, the vortex flows generated by the charge in all directions will squeeze the surrounding xtons uniformly. Therefore, the reverse pressure on the charge formed by the tension of the xtons in all directions around the charge will be consistent, and the charge will not move.

For two positively charged particles A and A', according to the right-hand screw rule, the directions of their vortex flows facing each other are opposite. The surrounding xtons will be tightened, resulting in a "tightening" relationship where the tension increases, and thus the resistance also increases. This "vortex spring" is compressed, causing the reverse force acting on the charges in the connecting direction to be greater than the combined reverse force acting on them in other directions. Therefore, the charges will move away from each other.

Similarly, for two oppositely charged particles B and B', the vortex flow directions of their electric fields are the same. Therefore, the surrounding xtons will be relaxed, resulting in a "loosening" relationship where the tension decreases, and thus the resistance decreases. The "vortex spring" releases potential energy and elongates, causing the reverse force acting on the charges in the connecting direction to be less than the combined reverse force acting on them in other directions. Therefore, the charges will move towards each other.

It can be seen that the xton vortex model can provide a good explanation for why charges of the same kind repel each other while charges of opposite kinds attract each other. This force arises from the disruption of the balance of xton tension around the charges, causing the charges to move in the direction of the resultant force.

We have already understood that the longitudinal transmission of xton vortices represents the energy of an electric field. Then, does the transverse transmission represent magnetic field energy? The answer is no. As we have known previously, a stable electric field does not induce a magnetic field, so the transverse transmission of xtons cannot be magnetic field energy. Since the emergence of a magnetic field coincides with the movement of xtons, magnetic field energy is likely the energy of xton movement.

8.4 What is a Magnetic Field?

Let's first investigate what happens when two xton rings on the same plane encounter each other. If both rings are not rotating, nothing will happen between them. According to classical mechanics, two stationary xton rings, even if there is significant energy transfer between the xtons within the rings, will not attract or repel each other after they encounter.

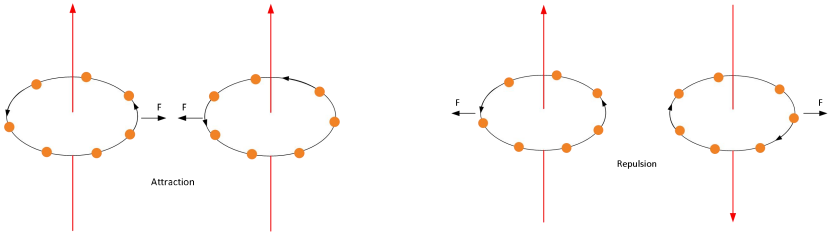
Unlike the xton vortices generated by charges, where the charge experiences an inward pressure from the tension of the surrounding xtons, the xtons around an xton ring create an outward pulling force on the ring. The directions of these two forces are opposite.

If there is only one xton ring, the pulling forces from the xtons around the ring are uniform and cancel each other out, so the ring will not move.

If two xton rings rotating in the same direction encounter each other, as shown in Figure 8.7(a), the velocity directions of the adjacent parts of the two rings are opposite. Therefore, the xtons at the neighboring locations of the two rings will be "tightened" and have greater tension. The rings will experience a larger pulling force in the connecting direction, and the xton rings will be pulled closer together. Thus, two xton rings rotating in the same direction will exhibit mutual attraction.

On the other hand, if two xton rings rotating in opposite directions encounter each other, as shown in Figure 8.7(b), the velocity directions of the adjacent parts of the two rings are the same. Therefore, the xtons at the neighboring locations of the two rings will be

"relaxed" and have less tension. The rings will experience a smaller pulling force in the connecting direction, and the xton rings will be pushed further apart. Thus, two xton rings rotating in opposite directions will exhibit mutual repulsion.



(a) Same-direction xton rings attract each other

(b) Opposite-direction xton rings repel each other

Figure 8.7: The interaction forces between xton rings

The repulsion and attraction phenomena exhibited by xton rings are consistent with the magnetic field around a straight wire carrying a current. We know that a magnetic field exists around a straight wire carrying a current. If we place two straight wires parallel to each other and pass a current through them, a circular magnetic field will be generated around the wires, as shown in Figure 8.8(a). When the current directions are the same, the rotation directions of the magnetic fields are also the same, and they will attract each other; when the current directions are opposite, they will repel each other.

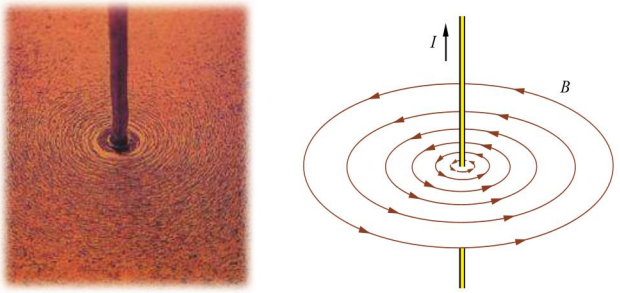


Figure 8.8: The magnetic field around a current-carrying wire

It seems that this has already revealed to us that a magnetic field is essentially rotating xton rings, and the magnetic field lines describe the rotation of these xton rings, as illustrated in Figure 8.8(b). The direction of rotation of the xton rings determines the direction of the magnetic field, which follows the right-hand rule. We already know that the longitudinal energy transfer of xton vortices represents electric field energy. Therefore,

it can be said that the direction of rotation of xton rings determines the direction of the electric field, following the right-hand screw rule. Magnetic field energy only exists in rotating xton rings, and stationary xton rings do not possess magnetic field energy.

In this way, we have unlocked the mystery of magnetic fields. Magnetic field energy originates from the rotation of xton rings. If the xton vortex energy is stable, while the xton rings are transmitting energy, only the xtons on the front of the vortex are moving, and the xtons in other areas remain stationary. Therefore, there is no magnetic field energy. Only when the xton vortex energy changes and the tension balance of the xton rings is disrupted, will the rings rotate following the change in xton vortex energy. At this point, the xton rings possess magnetic field energy. When the xton rings regain their balance and stop rotating, the magnetic field energy will also disappear simultaneously.

Therefore, for continuously stable xton vortices, there is only an electric field and no magnetic field. Magnetic field energy is generated only when the xton vortex energy changes, and the transmission of changing electric and magnetic field energies constitutes electromagnetic waves. When the frequency of this energy change falls within the visible range of the human eye, it is visible light.

8.5 What Is Charge?

We have already learned that xton vortices provide a good explanation for electric and magnetic fields. Then, where does the initial energy of xton vortices come from? According to classical physics, charges can generate electric fields, which means that the starting energy of xton vortices originates from charges. We can imagine that inside a charge, there exist stably rotating xton rings, providing a stable energy output.

According to classical physics, a circular current can induce a magnetic field perpendicular to the plane of the circle, and a circular magnetic field can also induce an electric field perpendicular to the plane of the circle. Corresponding to a circular current, a circular magnetic field can be referred to as a circular magnetic flux. Below, we present a model of how charges generate electric fields, as shown in Figure 8.9:

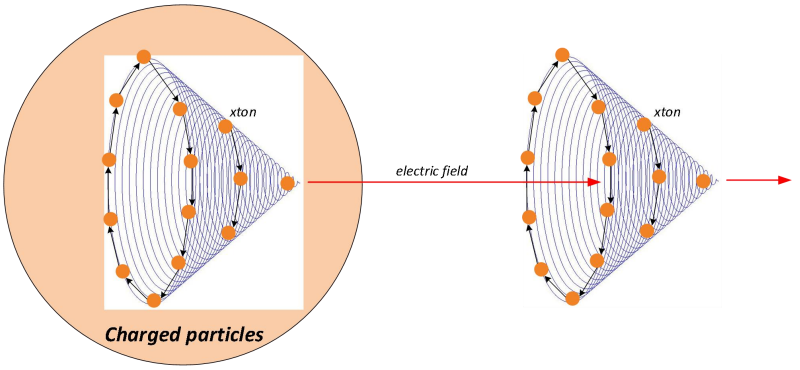


Figure 8.9: The xton vortices within a charged particle generate electric field energy.

The continuous rotation of xton vortex (magnetic flux) within a charge forms an electric field. The direction of rotation of the xton vortex determines the direction of the electric field, thus also determining the positive or negative nature of the charge, which is quite interesting. Electrons in an atom move rapidly and randomly around the nucleus, giving the xton vortex the opportunity to face any direction, resulting in the generation of electric fields in all directions around the electron. According to the right-hand screw rule, clockwise rotation represents a positive charge, while counterclockwise rotation represents a negative charge.

8.6 Summary of Electric and Magnetic Fields

We have proposed that the microscopic structure of electric and magnetic fields is xton vortices. An electric field represents the longitudinal energy transfer of xton vortices, with the direction of xton vibration perpendicular to the direction of electric field energy transfer. Therefore, an electric field is a transverse wave mediated by xtons, and in a vacuum, this transverse wave travels at the speed of c. A stable electric field does not generate a magnetic field, but a changing electric field induces a circular magnetic flux, thus forming a magnetic field. The direction of magnetic field energy transfer (radial) is perpendicular to the direction of xton ring rotation (tangential). Hence, a magnetic field is also a transverse wave mediated by xtons, traveling at the speed of c in a vacuum. It is precisely because both electric and magnetic fields are xton transverse waves that they possess the same speed.

Of course, the xton vortex model is just a physical representation, and we cannot claim that it is the absolute truth. The physical model constructed from xtons requires further verification. However, it seems that the xton vortex model provides a good explanation for

electric and magnetic fields and constructs a sound foundation for charges.

Since xton transverse waves transfer electric and magnetic field energies, what energy is transferred by xton longitudinal waves, and at what speed? As evident from Figure 8.9, the speed of energy transfer in a rotating forward motion is bound to be significantly slower than that of direct forward transfer. Therefore, we can confidently state that the speed of xton longitudinal waves must be much greater than the speed of light.

8.7 Maxwell's Equations

Building upon previous research, particularly the work of Michael Faraday, Maxwell developed the electromagnetic theory. In 1831, Faraday proposed Faraday's law of electromagnetic induction, which describes the induced electric field due to changes in the magnetic field. Maxwell further developed Faraday's theory and unified it with the theory of electric fields, leading to the formation of Maxwell's equations. These equations constitute a set of fundamental equations that describe the behavior of electromagnetic fields. They consist of four equations, both in integral and differential forms. The following will introduce the physical significance of each function.

8.7.1 Gauss's Law

Integral Form:

$$\oint E \cdot dA = \varepsilon_0 Q / \varepsilon \tag{8.1}$$

Differential Form:

$$\nabla \cdot E = \rho / \varepsilon_0 \tag{8.2}$$

This equation describes the generation and distribution of electric fields. On the left side is the integral of the electric field E over a closed surface, and on the right side is the charge density ρ within that closed surface. ε_0 is the vacuum permittivity, ε is the permittivity, Q is the total charge within the closed surface. This equation indicates that the source of the electric field is charge, and electric field lines emanate from positive charges. In other words, the total energy of the electric field distributed over the closed surface is directly proportional to the charge, equivalent to evenly distributing the charge over the closed surface. This is consistent with the relationship between charge and electric field described in Figure 8.9. The amount of charge determines the strength of the electric field energy.

8.7.2 Gauss's Law for Magnetism

Integral Form:

$$\oint B \cdot dA = 0 \tag{8.3}$$

Differential Form:

$$\nabla \cdot B = 0 \tag{8.4}$$

This equation describes the behavior of the magnetic field. It states that the integral of the magnetic induction B over any closed surface is zero, as shown in Figure 8.10. This implies that the number of magnetic induction lines entering and leaving a closed surface is equal. In other words, the total number of magnetic field lines on a closed surface remains constant; they neither have a source (magnetic charge) nor a sink (magnetic monopole). This is the statement of Gauss's law for magnetism, indicating that isolated magnetic charges do not exist, and the origin of the magnetic field can only be electric currents or changing electric fields.

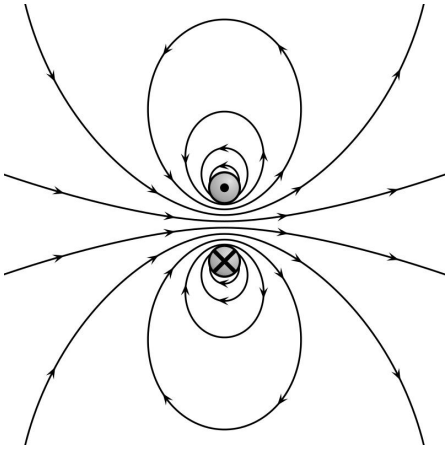


Figure 8.10: Gauss's Law for Magnetism: Magnetic field lines never begin or end; instead, they form loops or extend to infinity, as demonstrated here by the magnetic field generated by a current loop.

The magnetic field under Gauss's Law for Magnetism and the magnetic field energy described in Figure 8.7 are consistent. The energy of Xton's moving loop is the magnetic field energy, and the "loop's characteristic" determines that the magnetic field obeys Gauss's Law for Magnetism.

8.7.3 Faraday's Law of Electromagnetic Induction

Integral Form:

$$\oint E \cdot dl = -d\phi B / dt \tag{8.5}$$

Differential Form:

$$\nabla \times E = -\partial B / \partial t \tag{8.6}$$

This equation describes the induced electric field due to changes in the magnetic field. On the left side is the line integral of the electric field E around a closed loop, and on the right side is the negative rate of change of the magnetic flux ΦB with respect to time. This equation indicates that a changing magnetic field can generate an induced electric field, following Faraday's law of electromagnetic induction. As shown in Figure 8.11.

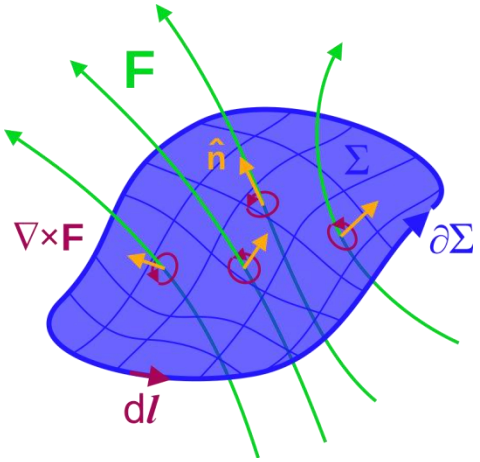


Figure 8.11: Surface Σ with a closed boundary $\partial \Sigma$. F can be the E or B field. Similarly, n is the unit normal. (The curl of a vector field doesn't actually look like "circulation" as described heuristically.)

Specifically, this means that when the magnetic field changes, the direction of the induced electric field will be opposite to the direction of the magnetic field change, thus resisting the magnetic field change. This aligns with the fundamental principle of Faraday's law of electromagnetic induction, which states that a changing magnetic field induces an electric field whose direction opposes the change in the magnetic field. This phenomenon is crucial in many practical applications; for instance, the operation of devices like transformers, induction motors, and other equipment involves this electromagnetic induction phenomenon.

The electromagnetic field behavior demonstrated by Faraday's law of electromagnetic induction is consistent with the magnetic field described in Figure 8.4. The magnetic field

resists changes in the electric field, effectively generating a field in the opposite direction. This is why there is a negative sign on the right side of equations (8.5) and (8.6).

8.7.4 Ampère's Circuital Law

Integral Form:

$$\oint B \cdot dl = \mu_0 (I + \varepsilon_0 d\phi E / dt) \tag{8.7}$$

Differential Form:

$$\nabla \times B = \mu_0 J + \mu_0 \varepsilon_0 \partial E / \partial t \tag{8.8}$$

This equation describes the magnetic field generated by current and changing electric fields. On the left side is the line integral of the magnetic induction B around a closed loop, and on the right side is the product of the current I within that closed loop and the rate of change of the electric flux ΦE with respect to time. J represents the current density, and μ_0 is the vacuum permeability. This equation indicates that current and changing electric fields can generate a magnetic field, following Ampère's circuital law.

This means that electric currents produce magnetic fields, and changing electric fields can also generate magnetic fields. In fact, Ampère's circuital law can be further simplified to state that "changing electric fields generate magnetic fields" because electric currents result in a consistent variation of the electric field, thereby creating a steady magnetic field. The behavior of the electromagnetic field reflected in Ampère's circuital law is consistent with the behavior exhibited by Xton vortices.

When the electric field steadily increases, Xton will continuously rotate forward, generating a stable magnetic field, effectively creating a stable opposing electric field to counteract the strengthening electric field.

When the electric field steadily decreases, Xton will continuously rotate backward, producing a stable magnetic field, akin to generating a stable electric field in the same direction to counteract the weakening electric field.

8.7.5 Summary of Maxwell's Equations

It can be stated that the Xton vortex model can effectively explain the Maxwell's equations. Simultaneously, Maxwell's equations provide the mathematical equations for the Xton vortex model, allowing the electromagnetic field theory based on the Xton model to not

only be a qualitative analysis but also a quantitative computation.

Maxwell's equations are used to describe the behavior of electromagnetic waves, i.e., the behavior of dynamic electric fields. However, although there is no magnetic field present around a static electric field, this does not affect the propagation (or extension) of the static electric field. Therefore, it is necessary for us to further analyze and understand Maxwell's theory.

When I finished section 8.7, I did not doubt the validity of Maxwell's theory. However, during a discussion on electromagnetic waves with Professor D.M., he put forward some viewpoints derived from Maxwell's theory that surprised me. This made me start to question whether Maxwell's theory is merely a summary of surface phenomena of electromagnetic waves, rather than a truly correct interpretation of the behavior of electric fields, magnetic fields, and electromagnetic waves. These viewpoints will be discussed in detail in section 14.10 of the book.

We often tend to blindly trust great theories. However, when we start thinking independently, we may be surprised, just like I was. Therefore, continuous and in-depth reflection on Maxwell's theory or other theories is crucial. Hence, I have included this passage here.

Chapter 9
Gravitational Fields and Gravitational Waves

From natural phenomena, in general, the speed at which energy propagates through medium particles in the form of longitudinal waves is far greater than the speed of transverse waves. This also aligns with our analysis. Therefore, there is sufficient reason to believe that the longitudinal wave velocity of xtons will definitely be much greater than the transverse wave velocity, c. Newton informs us that the speed of the gravitational field is vastly greater than the speed of light. Hence, we can boldly speculate that gravitational field energy is transmitted through xtons in the form of longitudinal waves, as depicted in Figure 9.1. The gravitational field affects the tension between surrounding xtons, but this impact is significantly smaller compared to the effect of the electric field. Thus, in a medium environment such as water or glass, the tension between xtons is greater than in a vacuum. However, if the surrounding gravitational field is extremely strong, then the gravitational field becomes the primary factor influencing the tension between xtons. At this point, the speed of light will be less than c; for instance, around a black hole, the speed of light becomes exceedingly slow.

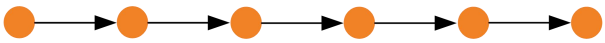


Figure 9.1: Gravitational field energy is transmitted through the longitudinal vibrations of xtons, forming a "chain of xtons."

An explanation is needed here: the statement that the gravitational field affects the tension between surrounding xtons is not correct. In the following, we will understand that the gravitational field is actually the tension field between xtons, where the intensity of the gravitational field reflects the intensity of the tension field between xtons.

The energy of the gravitational field is transmitted in all directions at a very high speed in the form of longitudinal waves of xton, which is consistent with Newton's law of universal gravitation. General relativity also believes that under weak gravitational fields, the E-I-H equation is approximately equal to Newton's gravitational equation, which has actually recognized that the speed of the gravitational field is much greater than the speed of light.

The energy of the gravitational field is transmitted in all directions, forming a spherical

field. Around celestial bodies, there are xton spherical surfaces that form tensions pointing to the center of the sphere. As shown in Figure 9.2:

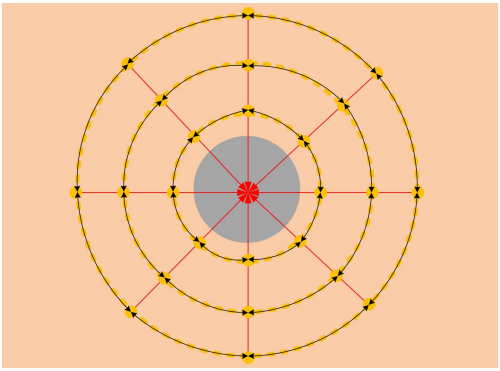


Figure 9.2: Gravitational Field: The xton Tensile Field Surrounding Celestial Bodies

The gravitational field extends from the center of the sphere, and radially speaking, it appears as individual "xton chains," as shown in Figure 9.1. Changes in celestial body information, such as mass and position, are transmitted through these chains in the form of longitudinal waves, at a speed far greater than c. The closer one is to the celestial body, the greater the tension between xtons, and the stronger the gravitational field becomes.

9.1 Gravity

Why do two objects attract each other rather than repel? We have already provided a similar answer when analyzing the force between charges. If we consider two celestial bodies, A and B, as shown in Figure 9.3:

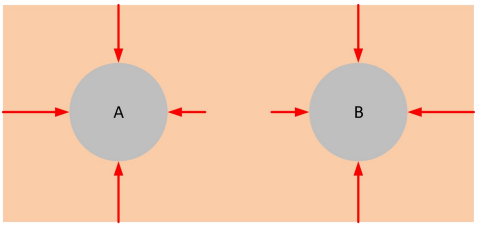


Figure 9.3: The Gravitational Force between Celestial Bodies A and B

The xtons around A are squeezed by A, forming a certain tension pointing towards the center of A's sphere. Similarly, the xtons around B also form a tension pointing towards the center of B's sphere. However, the xtons along the line connecting A and B are squeezed by A and B in opposite directions, creating a cancelling effect that makes the tension

between A and B "relaxed". This results in a thrust force pushing A towards B and vice versa, giving the appearance of A and B "attracting" each other and moving closer. This thrust force is the gravitational force in classical physics, and the gravitational field is actually a tension field formed by the squeezing of xtons. Therefore, celestial bodies automatically possess a gravitational field without the need to expend energy, and the position and mass information between them is transmitted through simple collisions between xtons, as illustrated in Figure 9.1. Compared to the way electric and magnetic field energies are transmitted through xton vortices, the transmission of gravitational field energy is much simpler and more direct.

This is quite fascinating. The gravitational force between two celestial bodies is actually a thrust force rather than an attractive force, and the gravitational field is simply a tension field pointing towards the center of the sphere, formed by the “squeezing” of xtons by the celestial bodies.

One can imagine that under the action of gravity, the xtons surrounding a celestial body would move along with it. Nearer to the celestial body, the xtons would also rotate with it. Consequently, light on the Earth's surface would move with the rotation of the Earth, meaning that light would acquire the Earth's velocity. Taking the Earth as a reference, the speed of light measured in any direction on Earth would be c, naturally making it impossible to observe any shift in the fringes. [4] The MMX experiment provides strong experimental evidence for the xton-based gravitational field model.

Gravitational waves have been a hot topic in recent years. Are gravitational waves also a certain type of energy inherent to xtons, similar to magnetic fields? Or are they a type of energy transmitted by xtons, analogous to electric fields?

9.2 Gravitational Waves

According to the General Theory of Relativity, disturbances in the gravitational field can give rise to gravitational waves. These disturbances stem from the movement of celestial bodies affecting the gravitational fields of other surrounding celestial bodies. The gravitational field of a celestial body moves along with the body itself. If the gravitational fields from other celestial bodies surrounding a celestial body are extremely weak, meaning the tension between xtons in the space where the celestial body moves is very faint, then the ability to resist collisions is also weak. Consequently, the gravitational waves

generated by collisions can be negligible.

However, if there are prominent gravitational fields present in the vicinity, the scenario is quite the opposite. There exists a certain tension between xtons, and disturbances caused by interactions of celestial bodies with other gravitational fields will induce more noticeable gravitational waves around the celestial bodies. Therefore, gravitational waves around celestial bodies mainly originate from the disturbances caused by celestial bodies interacting with other gravitational fields in their vicinity.

Next, let's take the Sun as an example to illustrate the gravitational waves around it.

9.3 Gravitational Waves around the Sun

We have already learned that the gravitational field transmits energy through longitudinal waves of xtons, which are controlled by the gravitational field, causing them to move along with the gravitational source. For example, in the case of the Sun, xtons within the Sun's gravitational field control range will move along with the Sun, and xtons closer to the Sun will also rotate with the Sun's rotation. However, as the distance increases, the speed of xtons rotating with the Sun will gradually decrease.

Now, what happens when the Sun encounters xtons controlled by the gravitational field of another celestial body? We know that as celestial bodies move in the universe, the Sun will collide its own xtons with those of other celestial bodies, causing the xtons to vibrate. This vibration manifests as xton waves that spread out in all directions, which we can refer to as xton tension waves. As shown in Figure 9.4.

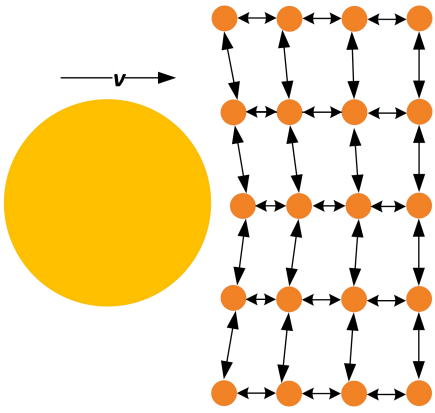


Figure 9.4: Tension Waves (Gravitational Waves) Resulting from the Sun Colliding with

According to classical physics theory, this wave is primarily manifested as a transverse wave. Due to the tension between xtons, the tension wave generates a reaction force F, pointing towards the center of the Sun.

For the Sun, the tension waves around it will cause planets to feel a force pushing them towards the Sun. This force is in the same direction as the Sun's gravitational force, and it will affect the planets' orbits. Since the effect of xton tension waves is similar to gravity, we refer to it as "xton gravitational waves" or simply "gravitational waves." Now, which gravitational field's perturbation primarily generates the gravitational waves around the Sun? How are the gravitational waves distributed? How do we calculate the "gravity" generated by gravitational waves? We will delve into these details in Chapter 10: "Calculation of Planetary Orbits under the Influence of Gravitational Waves."

We have described the gravitational field using the xton tension field, which is consistent with Newton's law of universal gravitation. We have also described gravitational waves using xton tension waves, gradually unveiling the mysteries of gravity. However, Newton's gravitational equation does not take into account the effects of gravitational waves, so it can be anticipated that there will be some deviations in the calculation of planetary orbits using Newton's equation. This is indeed the case.

Einstein's general relativity explains gravity through the curvature of spacetime, and we need to make a comparative analysis.

9.4 Differences and Connections between Newtonian Gravity and General Relativity's Gravity

Einstein believed that mass causes spacetime to curve, with the curvature speed equalling the speed of light, c. Gravity arises from the curvature effect of spacetime. According to the General Theory of Relativity, mass causes space to curve, leading to objects moving along this curved space. The product of an object's mass and its acceleration is equivalent to the effect of gravity. As celestial bodies move, the curved space surrounding them changes accordingly, with this change propagating at the speed of light, c.

The model of spacetime curvature has a certain similarity to our understanding of celestial bodies squeezing xtons to form a tension field, but we differ in our views on the speed of energy transmission in the gravitational field.

Einstein posited that spacetime curvature has persisted for a long time, extending to distant places. When the position of a gravitational source changes, the curvature of spacetime adjusts accordingly at the speed of c, producing ripples in the spacetime curvature known as Einstein's gravitational waves. It takes a very long time for this curvature update to propagate to the edges of galaxies.

For example, we know that the Milky Way Galaxy has a diameter of 180,000 light-years, and the galactic center is moving at a speed of 600 km/s. This means that the gravitational field is constantly adjusting, but this adjustment takes 90,000 light-years to reach the edges of the Milky Way. Obviously, distant celestial bodies would lag behind in keeping up with the changing gravitational field of the Milky Way and move away. However, this issue does not arise in Newton's theory of gravity.

The biggest distinction between Newton's law of universal gravitation and general relativity lies in their perspectives on the speed of energy transmission in the gravitational field. According to our calculations, if the speed of the gravitational field is equal to the speed of light, it would cause instability in the orbits of celestial bodies. However, the planetary orbit data released by NASA is derived from astronomical observations and calculations using the Einstein-Infeld-Hoffmann (E-I-H) equation[28], which is based on general relativity. So, could there be an error in our analysis and calculations? Or have we misinterpreted Einstein's view on the speed of energy transmission in the gravitational field?

[28] The E-I-H equations are gravitational equations established based on General Relativity (GR) for calculating celestial body orbits. However, in practical applications, the E-I-H equations do not account for the gravitational time delay effects caused by the slow speed of light, c. Instead, in weak gravitational fields, General Relativity approximates Newtonian gravity, so the E-I-H equations assume an infinitely large gravitational speed. In a sense, the E-I-H equations make an approximation, or they have corrected an erroneous view of gravity speed in GR. Therefore, the E-I-H equations can be seen as an improvement upon Newton's law of universal gravitation, using spacetime curvature to eliminate computational biases introduced by applying Newton's law. However, the success of the E-I-H equations also raises questions: What would the results be if we consider the effects of the slow gravitational speed in calculations? Computer simulations show that slow

gravitational speeds can make celestial body orbits unstable. See Figure 9.5:

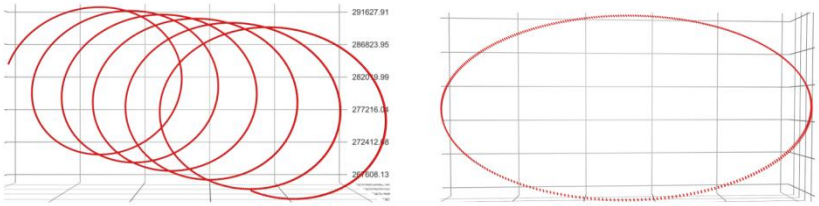


Figure 9.5: When the gravitational speed equals the speed of light c, celestial body orbits no longer remain stable ellipses.

Therefore, the E-I-H equations' neglect of the influence of gravitational speed is not an approximate calculation but a correction to the view of gravitational speed in General Relativity (GR). Both Newton and Laplace believed that the speed of gravity is extremely large. Laplace, through the study of the moon's orbit, estimated that the speed of gravity is approximately 7 million times the speed of light. Based on the rate of expansion of Earth's orbit, we calculated that the speed of gravity is approximately 10 million times the speed of light, as discussed in Chapter 11, "Doppler Effect of Gravity Fields.” Professors Michal Krizek from the Czech Academy of Sciences and Tom Van Flandern from the United States have provided excellent arguments regarding gravitational speed in their papers. [28a][28b]

In weak gravitational fields, General Relativity approximates to Newtonian gravity, and the E-I-H equations assume an infinitely large gravitational speed. This essentially agrees with Newton's view that gravity is an instantaneous force. Therefore, we believe that in weak fields, Einstein effectively acknowledges that the speed of gravity is far greater than the speed of light, although supporters of General Relativity still adhere to the belief that the speed of gravity equals the speed of light. They simultaneously argue for the equality of the speeds while assuming that the speed of gravity is much greater than the speed of light, which is highly illogical and perplexing.

After resolving the disagreement regarding the speed of gravity, we must acknowledge that Einstein's spacetime curvature model and our Xton tension field model are very similar. However, in three-dimensional space, using spacetime density instead of spacetime curvature would be more logically consistent. Otherwise, General Relativity would have to confront an awkward question: in a 3D space where mass can curve space, which way does the space around a celestial body bend? To the left? To the right? Up or

down? Therefore, describing gravity in 3D space with a 2D curved surface is not entirely appropriate; using spacetime density would be more suitable. Nevertheless, in a 2D plane, "curvature" is a vivid concept, hence we will continue to use the description of spacetime curvature in General Relativity. (We must face this reality: the concept of spacetime curvature has become deeply ingrained in popular understanding.)

Here we need to repeat a passage from our first chapter:
In 2005, Robert B. Laughlin (Physics Nobel Laureate, Stanford University), wrote about the nature of space: "It is ironic that Einstein's most creative work, the general theory of relativity, should boil down to conceptualizing space as a medium when his original premise [in special relativity] was that no such medium existed ... The word 'ether' has extremely negative connotations in theoretical physics because of its past association with opposition to relativity. This is unfortunate because, stripped of these connotations, it rather nicely captures the way most physicists actually think about the vacuum. ... Relativity actually says nothing about the existence or nonexistence of matter pervading the universe, only that any such matter must have relativistic symmetry."

General Relativity ultimately returns to the path of the medium that it initially believed did not exist. I believe that any truth coming to light undergoes such twists and turns. We hope to progress hand in hand with General Relativity, but this indeed requires supporters of General Relativity to acknowledge the issues they face rather than stubbornly persisting in their arrogance.

However, there are deviations between the orbital data calculated using Newton's gravitational equation and astronomical observations. For instance, the 43"/century discrepancy in Mercury's perihelion precession serves as a prime example. This is because Newton did not take into account the influence of xton gravitational waves, so there is bound to be a deviation in the results calculated using Newton's gravitational equation. This, in turn, provides indirect evidence for the existence of xton gravitational waves, albeit weak, whose effect on planetary orbits cannot be overlooked.

9.5 Summary of Gravitational Fields and Waves

The energy of the gravitational field is transmitted through Xton longitudinal waves, with a speed significantly greater than the speed of light, providing a theoretical basis for Newton's view that "gravity is an instantaneous force." The Xton gravitational waves caused by collisions are the transverse waves of Xton as the medium, with a speed equal

to the speed of light. **Therefore, it is no coincidence that LIGO detected gravitational waves moving at the speed of light.** Xton provides a unified physical model for the gravitational field and gravitational waves. In a weak-field environment, assuming that the speed of gravity is much greater than the speed of light as in the E-I-H equations, Einstein's spacetime curvature model and our Xton tension field model are very similar. It can be said that we have taken different paths to arrive at the same destination.

We have established a unified physical model based on xton for studying the most common phenomena of light and gravity in the universe. According to this model, we can effectively explain electric fields, magnetic fields, gravitational fields, gravitational waves, and the internal structure of charges. Experiments such as light refraction, reflection, Fizeau's experiment on light propagation in moving media, and deviations in planetary orbits all point to the existence of xton. Xton plays a crucial role as a medium for energy transmission in the universe, and it is the most important and fundamental particle in the cosmos.

Next, we will focus on studying the effects of the gravitational field and waves constructed by xton on planetary orbits. Although the speed of the gravitational field is extremely fast, it is still finite. However, when using Newton's gravitational equation, we do not consider the delay effect caused by the speed of the gravitational field. So, how would planetary orbits change if we take into account the velocity effect of the gravitational field?

Additionally, if we consider the gravitational waves around the sun, how should we calculate their magnitude and distribution? And what impact would these gravitational waves have on planetary orbits? Would the resulting orbits align with astronomical observations? In other words, the calculation of planetary orbits is also a meaningful validation of the unified field theory.

Before delving into the study of planetary orbits, we first need to have a clear understanding of what is known as the Doppler effect in energy transmission.

Chapter 10
Doppler Effect in Energy Transmission

The Doppler effect, also known as Doppler shift, refers to the change in the frequency of a wave relative to an observer moving with respect to the source of the wave. Named after physicist Christian Doppler, who described this phenomenon in 1842, a common example of Doppler shift is the change in pitch heard when a horn-honking car approaches and recedes from an observer. Compared to the emitted frequency, the received frequency is higher when approaching, the same when passing, and lower when receding. As shown in Figure 10.1, we provide a simple model of the Doppler shift.

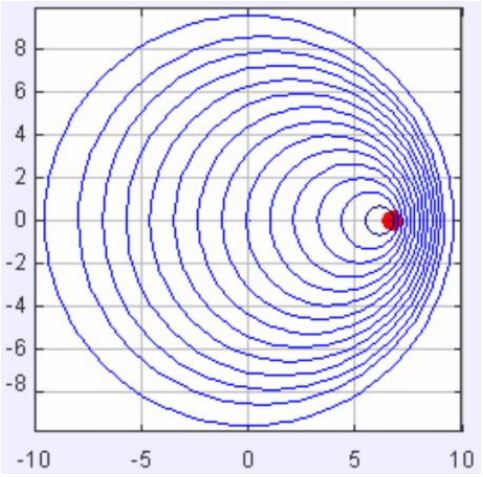


Figure 10.1: Doppler Shift

The fundamental reason for the Doppler shift is that the speed of a wave does not depend on the sender (source) or the receiver, but only on the medium. The speed of the wave is superimposed on the velocity of the medium. For example, in the case of sound waves, the speeds of the observer and the source relate to the medium in which the wave propagates. Therefore, the Doppler effect can be caused by the motion of the source, the motion of the observer, the motion of the medium, or any combination of these factors.

10.1 Energy Analysis of the Doppler Effect

The Doppler effect appears as a change in frequency, but from the perspective of energy transmission, it represents a change in the energy received by the receiver. When the

receiver perceives an increase in frequency, it also means that the receiver receives more energy per unit time. Conversely, the energy decreases. If the speed of energy transmission is not greater than the speed at which the receiver is moving away, then the energy no longer acts on the receiver.

10.2 Doppler Effect in Gravitational Fields and Waves

The electric and magnetic fields that facilitate energy transmission through xton also exhibit the same Doppler effect, as evidenced by light. Similarly, gravitational waves also possess the Doppler effect, and since planets generally have significant orbital velocities, albeit much slower than the speed of light, these velocities are non-negligible. Consequently, the Doppler effect of gravitational waves is relatively pronounced. The Doppler effect of gravitational waves ultimately manifests as variations in the energy of gravitational waves received by planets, resulting in changes in their orbits. Later, we will present a gravitational calculation model under the influence of gravitational waves and derive the dynamic gravitational equation considering the effects of gravitational waves.

Gravitational fields also exhibit the Doppler effect, but due to the significantly higher speed of gravitational fields compared to the speed of light, the Doppler effect in gravitational fields is extremely subtle. However, we can still identify the influence of the Doppler effect in gravitational fields from subtle changes in planetary orbits. This provides us with a clue: by observing minor changes in planetary orbits, we can calculate the speed of gravitational fields.

Next, we will delve into the study of the Doppler effect in gravitational fields and waves.

Chapter 11
Doppler Effect in Gravitational Fields

Although the speed of the energy transmission in the longitudinal waves of Xton's gravitational field can be extremely high, it is certainly finite. Therefore, there must be a Doppler effect between gravitational field energy and objects. The Doppler effect in gravitational fields can affect the orbital mechanical energy of planets. Below, we will analyze in detail whether this effect can lead to an increase in the orbital energy of planets, causing a gradual expansion of their orbits.

11.1 Expanding Universe

The accelerated expansion of the universe is a problem that has perplexed physicists, and there is currently no theory in the world that can provide a very reasonable explanation for this phenomenon. The Earth is moving away from the Sun at a speed of 1.5 cm per year. At the current rate, it would take approximately 60 billion years for the Earth to escape the Solar System. One explanation for the Earth's movement away from the Sun is that the Sun's mass is decreasing every year, which leads to a decrease in the Sun's gravitational pull and consequently an expansion of the Earth's orbit. However, the Moon is also moving away from the Earth at a speed of 3.8 cm per year, which is clearly not due to a decrease in the Earth's mass. Other planets and satellites in the Solar System are also experiencing similar orbital expansion phenomena.

General relativity proposes a cosmological model that is homogeneous, curved in space, and governed solely by gravity. In this model, all matter in the universe is driven to attract each other, causing the universe to collapse under its own weight. However, it is evident that the universe has not collapsed. To explain the stability exhibited by the universe, Einstein introduced a cosmological constant into his equations, which could counteract the irresistible gravitational pull. The resulting universe neither contracts nor expands, which is Einstein's concept of a static universe. However, it has been proven that the static universe view is incorrect. The Hubble Telescope has observed that the wavelengths of light emitted by galaxies are continuously stretching and becoming longer, indicating that they are moving away from us at an increasing rate. This is known as the redshift phenomenon. Eventually, Einstein abandoned his theory of a static universe and adopted the theory of an expanding universe.

Not only is the universe expanding, but its expansion rate is accelerating. This means that galaxies further away from us are moving away at a faster rate than those closer to us. So, what mysterious force is driving this expansion? The hypothesis of dark energy has been proposed. It can be said that dark energy is a concept introduced into physics to explain the expansion of the universe, which cannot be explained by current physical theories.

11.2 Universal Gravitation Equation under the Doppler Effect of Gravitational Fields

Newton and Laplace both believed that the speed of gravity, i.e., the speed of energy transmission in gravitational fields, is immense but finite. We denote this finite speed of the gravitational field (or the speed of energy transmission in the gravitational field) as X. Now, consider two objects M and m separated by a distance r, as shown in Figure 11.1.

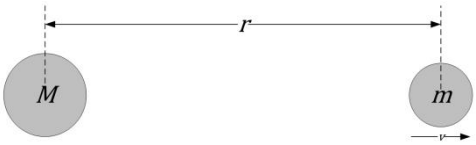


Figure 11.1: Model of Universal Gravitation

In this case, when they are at rest relative to each other, i.e., v=0, we do not need to consider the Doppler effect of the gravitational field. Their gravitational attraction can be calculated directly using Newton's law of gravitation. We denote the gravitational force between two objects with a relative velocity of v as F(v). Newton's law of gravitation can be referred to as the static gravitational equation.

$$F(0)=\frac{G_0 Mm}{r^2} \tag{11.1}$$

If the velocity v at which they are moving away from each other is not equal to 0, we need to consider the Doppler effect of the gravitational field. This involves multiplying the static gravitational equation of Newton by a Doppler factor f(v).

$$F(v)=\frac{G_0 Mm}{r^2}\times f(v), f(v)=\frac{X-v}{X} \tag{11.2}$$

It can be observed that when v=X, the gravitational field energy cannot catch up with m, and the gravitational force F(X)=0, as shown in Figure 11.2.

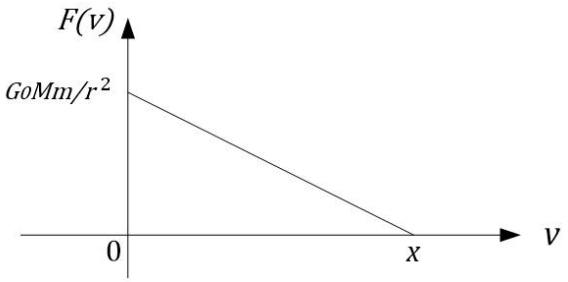


Figure 11.2: Linear relationship between gravity and velocity

If we want to maintain the form of Newton's law of gravitation, we can express it as:

$$F(v) = G(v) \times \frac{Mm}{r^2}, G(v) = G_0 \times \frac{X - v}{X} \tag{11.3}$$

In other words, the gravitational constant becomes a function of v, denoted as G(v). When the gravitational field has a different velocity relative to m, the gravitational constant also differs. Next, we will apply the gravitational equation under the Doppler effect of the gravitational field to the calculation of planetary orbits to determine if it is consistent with actual observations.

11.3 Calculation of the Impact of the Doppler Effect of Gravitational Fields on Earth's Orbit

Taking into account the angle between the velocity of an object and the direction of the gravitational field, we define v_r as the component of the velocity in the direction of the gravitational field, leading to a general formula:

$$F\left(v_r\right) = \frac{G_0 Mm}{r^2} \times \frac{X - v_r}{X} \tag{11.4}$$

This equation shows that when an object has a velocity component in the direction of the gravitational field, i.e., there is a motion effect in the same direction between the gravitational field and the object, the gravitational force it experiences decreases. Conversely, when the object has a velocity component opposite to the direction of the gravitational field, i.e., there is a motion effect in opposite directions between the two, the gravitational force increases. This leads us to consider the potential impact of the Doppler effect of the gravitational field on planetary orbits. Can planets maintain conservation of mechanical energy in their orbits?

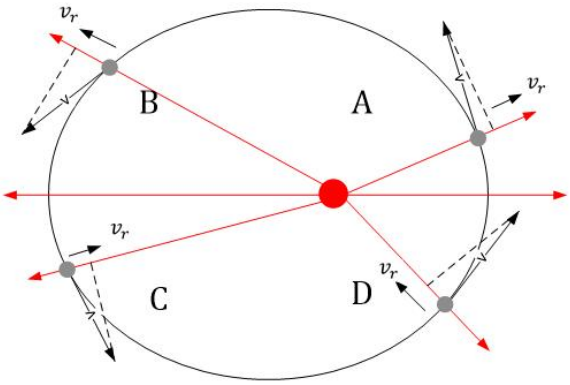


Figure 11.3: Velocity Component of a Planet in the Direction of the Gravitational Field

As shown in Figure 11.3, since the planet's velocity has the same directional component v_r in the direction of the gravitational field at points A and B, the gravitational force decreases. Consequently, the planet gains an additional force in the direction of the gravitational field, which is in the same direction as v_r. According to the power calculation formula $P=F*v_r>0$, the planet's mechanical energy increases.

In regions C and D, the planet's velocity has an opposite directional component vr in the direction of the gravitational field. This leads to an increase in the gravitational force. Therefore, the planet gains an additional force in the opposite direction of the gravitational field, which is in the same direction as v_r. Based on the power calculation formula $P=F*v_r>0$, the planet's mechanical energy also increases.

Under the Doppler effect of the gravitational field, the planet's mechanical energy continuously increases throughout its orbit, resulting in a gradual increase in its total mechanical energy. This would cause the planet to gradually move away from the Sun and ultimately escape the Solar System. Next, we will use the Earth as an example to calculate how many orbital periods it would take for the Earth to start escaping the Solar System. This calculation was provided by Professor Richard from the Austin Physics Institute. I have had numerous discussions with Professor Richard on gravitational topics, and he has been extremely helpful. I must express my gratitude to him.

11.3.1 Introduction of Polar Coordinates

Let the Sun with mass M be located at the origin. Consider a planet with mass m orbiting around the Sun. Let the planet's orbit lie in the x-y plane. Let r(t) be the position vector of

the planet relative to the Sun. The equation of motion for the planet is:

$$m\ddot{\mathbf{r}} = -\frac{G_0 Mm}{r^2} \times \frac{X - v}{X} \times e_r \tag{11.5}$$

where $e_r = \mathbf{r}/r$ and $v_r = e_r \cdot \dot{\mathbf{r}}$ .Let $r = |\mathbf{r}|$ and $\theta = \tan^{-1}(y/x)$ be plane polar coordinates. The radial and tangential components of (11.5) are

$$\ddot{r} - r\dot{\theta}^2 = -\frac{G_0 M}{r^2}\left(1 - \frac{\dot{r}}{X}\right) \tag{11.6}$$

$$r\ddot{\theta} + 2\dot{r}\dot{\theta} = 0 \tag{11.7}$$

Integrating (11.7) gives:

$$r^2\dot{\theta} = h \tag{11.8}$$

Where h is the conserved angular momentum per unit mass. Combining (11.6) and (11.8) gives:

$$\ddot{r} - \frac{h^2}{r^3} = -\frac{G_0 M}{r^2}\left(1 - \frac{\dot{r}}{X}\right) \tag{11.9}$$

11.3.2 Conservation of Energy

By multiplying (11.9) by , we obtain:

$$\frac{d}{dt}\left(\frac{\dot{r}^2}{2} + \frac{h^2}{2r^2} - \frac{G_0 M}{r}\right) = \frac{G_0 M\dot{r}^2}{r^2 X} \tag{11.10}$$

and

$$\frac{d\epsilon}{dt} = \frac{G_0 M\dot{r}^2}{r^2 X} \geq 0 \tag{11.11}$$

here

$$\epsilon = \frac{1}{2}\left(\dot{r}^2 + r^2\dot{\theta}^2\right) - \frac{G_0 M}{r} \tag{11.12}$$

This is the energy per unit mass. (11.11) shows that the Doppler correction to the law of universal gravitation leads to the system no longer conserving energy, and the orbital energy increases indefinitely, implying that the planet will ultimately escape the Sun's gravitational pull.

11.3.3 Solving the Equation of Motion

Let $1/r = u[\theta(t)]$. It follows that

$$\dot{r} = -h\frac{du}{d\theta} \tag{11.13}$$

$$\ddot{r} = -u^2 h^2 \frac{d^2 u}{d\theta^2} \tag{11.14}$$

In this case, (11.9) becomes:

$$\frac{d^2 u}{d\theta^2} - \gamma\frac{du}{d\theta} + u = \frac{G_0 M}{h^2}, \tag{11.15}$$

here

$$\gamma = \frac{G_0 M}{hX}, \tag{11.16}$$

This is a small dimensionless constant. At the first order in γ, a suitable solution to (11.15) is:

$$u \approx \frac{G_0 M}{h^2}(1 + e\exp(\gamma\theta)\cos\theta), \tag{11.17}$$

Where e is the initial eccentricity of the orbit. Therefore,

$$r(\theta) = \frac{r_c}{1 + e\exp(\gamma\theta)\cos\theta}, \tag{11.18}$$

here

$$r_c = \frac{h^2}{G_0 M}, \tag{11.19}$$

It can be observed that as the planet orbits the Sun, the orbital eccentricity grows indefinitely. Eventually, when the eccentricity reaches 1, the planet will escape the Sun.

11.3.4 Estimating the Escape Time

When its orbital eccentricity becomes 1, this planet will escape. Let's assume that the number of orbital periods required for this to happen is n.

$$e\exp(\gamma n 2\pi) = 1, \tag{11.20}$$

Where e is the initial orbital eccentricity. Therefore, $n = \frac{1}{2\pi\gamma}\ln\left(\frac{1}{e}\right)$,

$$\gamma = \frac{2\pi a}{TX\left(1-e^2\right)^{\frac{1}{2}}} \tag{11.21}$$

Where a is the initial orbital semi-major axis, and T is the initial orbital period. Therefore,

$$n = \frac{TX\left(1-e^2\right)^{\frac{1}{2}}\ln\left(\frac{1}{e}\right)}{4\pi^2 a} \tag{11.22}$$

For Earth, T=3.156×10^7 s, X=c =2.998×10^8 m/s, a=1.496×10^{11} m, and e = 0.0167. Hence, Earth would escape from the Sun's gravitational influence after

$$n = \frac{\left(3.156\times10^7\right)\left(2.998\times10^8\right)\left(1-0.0167^2\right)^{\frac{1}{2}}\ln\left(\frac{1}{0.0167}\right)}{4\pi^2\left(1.496\times10^{11}\right)} \approx 6.6\times10^3 \tag{11.23}$$

If each orbital period takes approximately 1 year, then the escape time would be thousands of years. However, the age of the solar system is 4.6 × 10^9 years. The escape time is approximately one million times smaller than this. Therefore, according to Equation (11.23), the speed of the gravitational field, X, must be significantly greater than the speed of light, which aligns more with Newton's argument that gravity acts instantaneously across vast distances.

If we could know the speed at which the Earth is moving away from the Sun, we could estimate the time it would take for the Earth to escape the solar system and calculate the speed of the gravitational field accordingly. If the Earth escapes the solar system after 60 billion years, based on this data, we can calculate that the speed of the gravitational field is at least 10 million (1 × 10^7) times faster than the speed of light, c (assuming the Earth orbits the Sun once every year). Laplace also performed calculations and estimated the

speed of the gravitational field to be 7 million (7×10^6) times faster than the speed of light, c. Astronomer Tom van Flandern also calculated the speed of gravity, and he determined it to be 20 billion times faster than the speed of light, c. These figures are all significantly greater than the speed of light, c.

11.4 Explaining Cosmic Expansion through the Doppler Effect of the Gravitational Field

The Doppler effect of the gravitational field can cause the mechanical energy of planetary orbits to continuously and slowly increase until the planets escape the solar system. If we know the escape velocity of a planet, we can calculate the speed of the gravitational field. Similarly, if we know the speed of the gravitational field, we can calculate the escape velocity of a planet. We can verify the correctness of this theory through astronomical observations. Human beings have not observed the existence of dark energy, perhaps due to limitations in human technology, or perhaps it does not exist at all. The Doppler effect of the gravitational field can lead to the expansion of planetary orbits, so we cannot but ask whether the expansion of the universe is also caused by the Doppler effect of the gravitational field?

Moving forward, let us investigate the impact of the Doppler effect of gravitational waves on planetary orbits.

Chapter 12
Calculation of Solar System Planetary Orbits under the Influence of Gravitational Waves

Using Newton's law of universal gravitation, we have been able to calculate the orbits and orbital precessions of the planets in the solar system with relatively high accuracy. However, there are discrepancies between these calculations and astronomical observations. For instance, the orbital precession of Mercury deviates by 43" per century. LIGO has detected gravitational waves originating from deep space, confirming the existence of gravitational waves. According to Einstein's general relativity, perturbations in the gravitational field cause gravitational waves. Therefore, the Sun's motion through the Milky Way also disturbs the gravitational field of the galaxy, resulting in the formation of gravitational waves around the Sun, albeit very weak ones. However, since the planets in the solar system are not far from the Sun, they will experience the influence of gravitational waves, which will affect their orbits. This paper will analyze the specific distribution of gravitational waves around the Sun, derive the dynamic gravitational equation under the influence of gravitational waves, apply it to the calculation of planetary orbits, and validate the correctness of the dynamic gravitational equation by comparing it with astronomical observation data released by NASA. This thoroughly demonstrates that universal gravity is the result of the combined action of gravitational fields and gravitational waves.

12.1 Detection of Gravitational Waves

The detection of gravitational waves is crucial for verifying general relativity and studying celestial phenomena in the universe. In recent years, through gravitational wave detection experiments such as LIGO (Laser Interferometer Gravitational-Wave Observatory) and VIRGO (European Gravitational Observatory), multiple gravitational wave events have been successfully detected, providing important evidence for astrophysics research. Perturbations in the gravitational field can originate from changes in the mass and energy of celestial bodies or from the influence of other celestial bodies. These perturbations give rise to the generation of gravitational waves.

Around the Sun, there exist gravitational fields from various sources. The Sun moves around the center of the Milky Way at a speed of 240 km/s, resulting in disturbances in the gravitational field surrounding the Sun. Based on this observation, we have ample reason

to believe that gravitational waves exist around the Sun and that these waves have an impact on the orbits of planets in its vicinity. By observing and analyzing gravitational waves, we can gain a better understanding of the interactions between celestial bodies and the distribution of gravitational fields in the universe. This, in turn, allows us to derive the motion laws of the planets in the solar system under the influence of gravitational wave environments.

12.2 Analysis of Gravitational Wave Energy

We must consider this question: In the space where the Sun resides, there exist various gravitational fields, such as the gravitational field from the center of the Milky Way (GFMWcenter), gravitational fields from other galaxies, and gravitational fields from planets. Among these, which gravitational field (GFX) does the Sun's perturbation primarily generate gravitational waves? To resolve this question, we need to first understand which factors affect the energy of gravitational waves. Assuming the Sun has a mass of M, a relative velocity of v with respect to GFX, an energy intensity of EIGFX for GFX, and a volume of V, the size of the space occupied by the Sun determines the quantity of GFX particles (xtons) it interacts with. According to classical mechanics, the perturbation energy of the Sun on GFX can be simply expressed as:

$$E_{\text{disturbance}} = KMv^2 * EI_{GF_X} * V \ , \tag{12.1}$$

Here, K is a constant, which means that the larger the mass of the Sun (M), the greater the speed of the Sun relative to GFX (v), the larger the energy intensity of GFX (EIGFX), and the larger the volume of the Sun (V), the greater the energy of the gravitational waves. The term Mv^2 represents the kinetic energy of the Sun relative to GFX, EIGFX represents the tension of GFX, and V represents the number of xtons within GFX. The disturbance energy of the Sun on GFX is directly proportional to Mv^2, EIGFX, and V.

To give an analogy, it's like a bullet colliding with numerous small balls of negligible mass. The greater the kinetic energy of the bullet, the more balls it hits, and the greater the tension between the balls. Consequently, the total energy of the resulting disturbances in these balls is greater.

Since the gravitational fields from other galaxies reaching the Sun are extremely weak relative to GFMWcenter, they can be ignored. However, we know that the intensity of the gravitational field from the Earth (GFEarth) on the Sun is 80 times that of GFMWcenter. Does this mean that the disturbance of the Sun on GFEarth is the primary source of gravitational waves around the Sun? The answer is no because the speed of the Sun relative to GFEarth (v1 = 0.00127 km/s) is very small compared to the speed of the Sun relative to GFMWcenter (v2 = 240 km/s). Substituting these values into equation (12.1), the ratio of their gravitational wave energies is:

$$\frac{v_2^2 * 1}{v_1^2 * 80} = \frac{240^2}{0.00127^2 * 80} = 4.46 * 10^8 \quad , \tag{12.2}$$

So, the disturbance of the Sun on GFEarth can be neglected. Similarly, the disturbance of the Sun on the gravitational fields of other planets, such as Jupiter, can also be ignored.

Additionally, we need to consider the gravitational waves generated by the disturbance of the Sun's gravitational field (GFSun) by the planets. Taking the Earth as an example, the gravitational force of the Sun on the Earth is 80 times that of the gravitational force from the center of the Milky Way on the Sun. The mass of the Sun is 330,000 times that of the Earth. Therefore, the intensity of GFSun around the Earth is 80 * 330,000 times the intensity of GFMWcenter around the Sun. The speed of the Earth relative to GFSun is 29.8 km/s. If we only consider the terms Mv^2EIGFX in equation (12.1), the ratio of the disturbance energy of the Sun on GFMWcenter to the disturbance energy of the Earth on GFSun is:

$$\frac{M_{Sun} v_2^2 * EI_{GFMWcenter}}{M_{Earth} v_1^2 * EI_{GFsun}} = \frac{330000 * 240^2 * 1}{1 * 29.8^2 * 80 * 330000} = 0.81 \, , \tag{12.3}$$

The Sun is slightly at a disadvantage in this scenario. However, due to the Sun's volume being 1.3 million times that of the Earth, the number of xtons it occupies in space is much larger than that of the Earth. Therefore, the energy of the gravitational waves caused by the disturbance of GFSun by the Earth can also be neglected. Similarly, the gravitational waves caused by the disturbance of the Sun's gravitational field by other planets like Jupiter can also be ignored.

Here, it's important to note that the Sun and the inner planets have different compositions, with the density of the inner planets being approximately 4 times that of the Sun. Therefore, we can simplify and consider that for the same volume, the number of xtons that the inner planets' material can interact with is 4 times that of the Sun, resulting in larger gravitational wave energy. As for the outer planets, their composition is similar to that of the Sun, but with lower density. Therefore, for the same volume, the gravitational wave energy would be smaller.

Is GFMWcenter the strongest gravitational field in the space where the solar system is located? We know that the mass of the galactic center in the Milky Way is relatively small compared to the entire galaxy, and the mass is mainly distributed in the galactic disk. Therefore, we need to consider the gravitational field generated by the arms of the galactic disk. We found the position data of the Sun in the Milky Way on astronomy.stackexchange[29]. As shown in Figure 12.1, the Sun crossed the galactic plane

approximately 3 million years ago, and currently, the Sun has moved to a position 17 pc (55 light-years) north of the galactic plane[30]. The Sun will continue to move north in the future, and in 13 million years, the distance between the Sun and the galactic plane will reach its maximum of 100 pc (326 light-years)[31]. After that, the Sun will move towards the galactic plane and reach it 290 million years from now. This means that the Sun spirals around the center of the Orion Arm in the Milky Way, crossing the galactic plane every 64 million years, which is similar to the Earth's spiral motion following the Sun. Next, we need to calculate the strength of the gravitational field (GFOrionArm) of the Orion Arm.

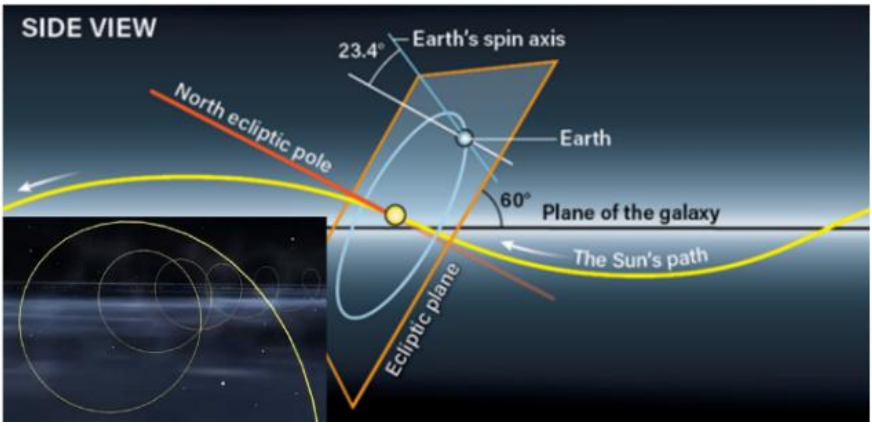


Figure 12.1: The path of the Sun crossing the galactic plane.

According to the centripetal force formula $F = m\omega^2 R$, we can estimate the ratio of GFOrionArm to GFMWcenter as follows:

$$\frac{\left(\frac{1}{6.4*10^7}\right)^2 *326}{\left(\frac{1}{2.2*10^8}\right)^2 *26000} = \frac{(2.2*10^8)^2 *326}{(6.4*10^7)^2 *26000} = 0.145\,, \tag{12.4}$$

the disturbance speed of the Sun on GFOrionArm is:

$$\frac{2.2*10^8 *326}{6.4*10^7 *26000} *240 = 10.3 \text{ km/s} \tag{12.5}$$

The ratio of the disturbance energy of the Sun on GFMWcenter to the disturbance energy of the Sun on GFOrionArm, according to equations (12.4) and (12.5), is:

$$\frac{240^2 *1}{10.3^2 *0.145} = 3744\,, \tag{12.6}$$

therefore, the disturbance of the Sun on GFOrionArm can be ignored. Here, $2.2 * 10^8$ years is the time for the Sun to orbit the Milky Way; $6.4 * 10^7$ years is the time for the Sun to

orbit the Orion Arm, with a radius of 326 ly; 26,000 ly is the distance from the Sun to the center of the Milky Way; 240 km/s is the orbital speed of the Sun.

Based on this, we can conclude that the gravitational wave generated by the disturbance of the Sun on other gravitational fields can be neglected, and the disturbance of the Sun on GFMWcenter is the primary source of gravitational waves around the Sun.

12.3 Analysis of the Gravitational Wave Energy Generated by the Disturbance of the Sun's Gravitational Field by the Planets

By taking into account the density factor of the planets, we can roughly estimate the contribution of the gravitational waves generated by the disturbance of the Sun's gravitational field by the Earth to the gravitational force on Earth. Although the gravitational waves around the Earth are relatively weak compared to the Sun, being only 1/0.81/1,300,000 times that of the Sun, the contribution cannot be ignored when studying the gravitational influence on the Moon, considering that the mass of the Earth is only 1/330,000 of the Sun's mass and the density ratio between the Earth and the Sun is 5514/1408. Now we define the ratio of the contribution of gravitational waves around the Sun to the gravitational field of the Sun as "*rw*", which is the ratio of the gravitational force contributed by the gravitational waves (FGW) to the gravitational force contributed by the Sun's gravitational field (FGF).

$$r_w = \frac{F_{GW}}{F_{GF}} \tag{12.7}$$

Therefore, according to equation (12.1), the ratio of the contribution of gravitational waves around the Earth to the gravitational force on Earth is:

$$\frac{r_w}{0.81} * \frac{1}{1300000} * 330000 * \frac{5514}{1408} = 1.25\, r_w \tag{12.8}$$

As we can see, the gravitational waves around the Earth are also worth considering.

Similarly, we can calculate the ratio data for other planets, as shown in Table 12.1:

Sun	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
rw	*1.16rw*	*2.68rw*	*1.25rw*	*0.038rw*	*3.02rw*	*0.15rw*	*0.0026rw*	*0.00079rw*

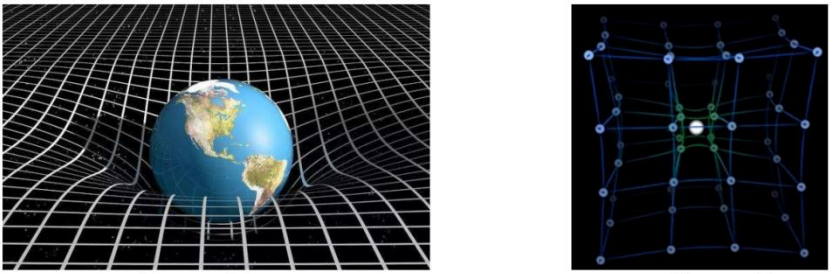
Table 12.1: Ratios of the gravitational force contributed by the gravitational waves around the Sun and planets to their respective gravitational forces.

Therefore, if we want to study the orbits of planets in the solar system, we only need to consider the gravitational waves caused by the disturbance of the Sun on GFMWcenter. However, if we need to calculate the orbits of planetary satellites, we must consider not only the gravitational waves around the Sun but also the gravitational waves caused by the planets. As shown in Table 12.1, we can see that Jupiter is 3 times the size of the Sun.

However, due to the fact that the gravitational field strength of Jupiter is only 1/1000 of the Sun at the same distance, the gravitational waves caused by the disturbance of Jupiter on GFSun can be neglected compared to the Sun. However, it has a significant impact on the satellites of Jupiter. To give an analogy, a small boat cannot disturb the entire ocean but can disturb the water around it.

12.4 Doppler Effect of Gravitational Waves

According to general relativity, mass can curve spacetime. However, space is three-dimensional, so this curvature is not a simple depression on a plane, as shown in Figure 12.2a, but rather as shown in Figure 12.2b. This is because the curvature caused by mass is equivalent in all directions in space. In other words, in 3D space, the spatial curvatures in different directions cancel each other out, resulting in the gravitational field propagating in straight lines. This is consistent with the description of gravitational fields in Newtonian gravity theory.



(a) 2D model (b) 3D model

Figure 12.2: Model of spacetime curvature caused by mass.

We know that the Sun is located within the Milky Way galaxy, so the spacetime characteristics around the Sun are based on the spacetime of the Milky Way. If the Sun were stationary relative to the center of the Milky Way, it would not cause any disturbance to GFMWcenter, and there would be no gravitational waves around the Sun. However, in the frame of reference of the Milky Way, the Sun is moving at a speed of 240 km/s. The Sun not only generates gravitational waves (which propagate at the speed of light, c), but it is also chasing after the gravitational waves, causing a Doppler effect on them. In the following, we will provide a detailed description of the entire process.

12.5 Impact of Gravitational Waves on the Gravity around the Sun

We already know that the gravitational waves around the Sun primarily come from the disturbance of GFMWcenter. Therefore, we take the center of the Milky Way galaxy as a

reference point for studying the gravitational waves around the Sun. As the Sun moves through GFMWcenter, if we consider the direction of the Sun's velocity as the axis, the distribution of gravitational waves around the Sun is axially symmetric. We only need to study the distribution of gravitational waves on a cross-section through the axis. This allows us to transform the three-dimensional spatial problem into a two-dimensional plane problem. As shown in Figure 12.3, in terms of its shape, it bears some resemblance to water waves.

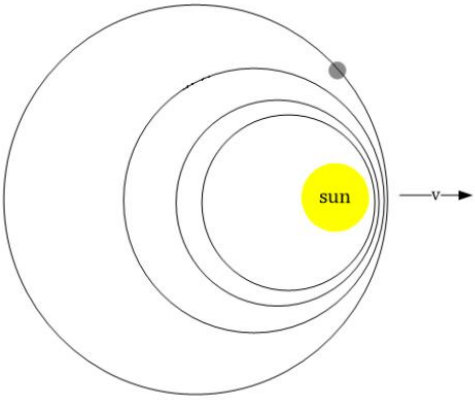


Figure 12.3: Model of gravitational waves around the Sun

Figure 12.3 demonstrates that due to the Doppler effect, the density of gravitational waves varies in different directions. The density is highest in the direction of the Sun's velocity, resulting in the greatest impact on gravity, gradually decreasing as we move away. Since the orbital planes of the planets are generally perpendicular to the direction of the Sun's velocity, the influence of gravitational waves on them is relatively smaller. Next, we need to mathematically derive the effects of gravitational waves on different directions around the Sun.

12.5.1 Calculation of the Doppler Factor for Gravitational Waves in the Direction of the Sun's Velocity

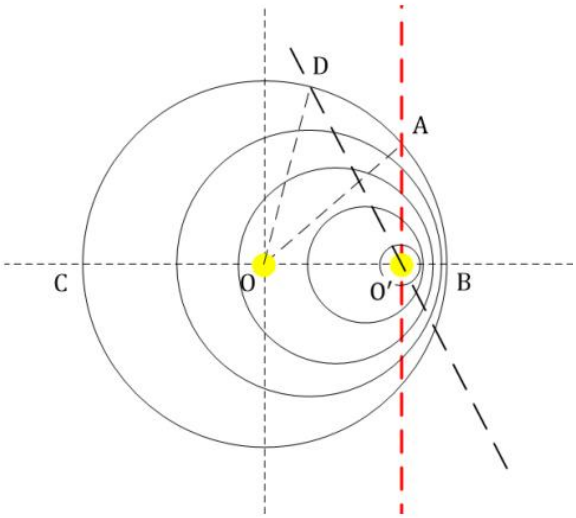


Figure 12.4: Model for calculating gravitational waves from the Sun

Assuming the orbital speed of the Sun is *vs*, as shown in Figure 12.4, after a time T, the Sun moves from position O to position O'. During this period, the gravitational waves generated along the direction of the Sun's velocity are located between O' and B. According to the Doppler effect, the Doppler factor for gravitational waves in this direction is as follows: (We will represent the Doppler factor of gravitational waves with *fw*).

$$f_w = \frac{c + v_s}{c} > 1.0 \tag{12.9}$$

12.5.2 Calculation of the Doppler Factor for Gravitational Waves in the Direction Perpendicular to the Sun's Velocity

The gravitational waves perpendicular to the direction of the Sun's velocity are located between O' and A. By calculating the ratio between O'B and O'A, we can determine the relationship of the gravitational wave density in these two directions.

$$O'B = cT - v_s T\ , \tag{12.10}$$

$$O'A = \left[(cT)^2 - \left(v_s T\right)^2 \right]^{\frac{1}{2}}\ , \tag{12.11}$$

get:

$$f_w = \frac{c + v_s}{c} \times \left(\frac{c - v_s}{c + v_s} \right)^{\frac{1}{2}} = \left(\frac{c^2 - v_s^2}{c^2} \right)^{\frac{1}{2}} \tag{12.12}$$

Substituting the values of the Sun's orbital speed, vs = 240*10^3 m/s, and the speed of gravitational waves, c = 2.998*10^8 m/s, we obtain:

$$\frac{O'B}{O'A} = \left(\frac{c - v_s}{c + v_s}\right)^{\frac{1}{2}} \approx 0.9992 \tag{12.13}$$

Figure 12.4 shows that the density of gravitational waves in the direction perpendicular to the Sun's velocity is lower than the density in the direction of the Sun's velocity. The distribution of gravitational wave density appears non-uniform, with the highest density along the direction of the Sun's velocity (bottom of Figure 12.5), gradually decreasing towards the surroundings.

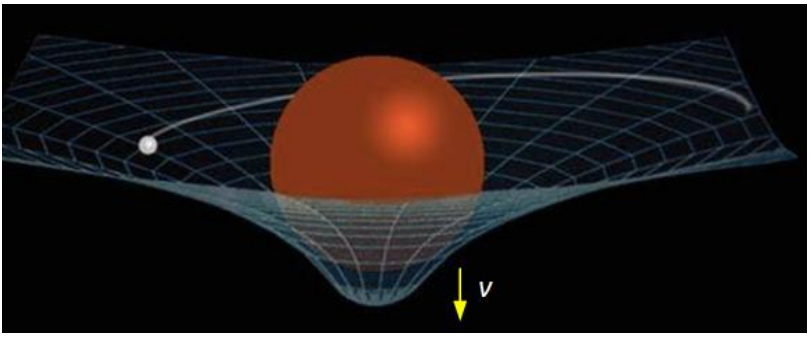


Figure 12.5: Model of gravitational wave density

12.5.3 Calculation of the Doppler Factor for Gravitational Waves in the Plane of Planetary Orbits

We know that the plane of planetary orbits is approximately perpendicular to the direction of the Sun's motion. Therefore, the vertical dashed line in Figure 12.4 represents the **ideal orbital plane** of the planet. Using equation (12.12), we can calculate the Doppler factor for gravitational waves in relation to the orbital plane, and determine that this value will be less than 1.0.

12.5.4 Calculation of the Doppler Factor for Gravitational Waves in the Direction Opposite to the Sun's Velocity

On the left side of the ideal orbital plane, the density of gravitational waves will continue to decrease, reaching its minimum in the direction opposite to the Sun's velocity. We obtain:

$$\frac{O'B}{O'C} = \frac{c - v_B}{c + v_B}, \tag{12.14}$$

The Doppler factor for gravitational waves is as follows:

$$f_w = \frac{c+v_s}{c} \times \frac{c-v_s}{c+v_s} = \frac{c-v_s}{c}, \tag{12.15}$$

By substituting *vs* = c into equations (12.12) and (12.15), we can determine that when the speed of the Sun reaches c (the speed of light), the ideal orbital plane and its left side will no longer be affected by gravitational waves.

12.5.5 Calculation of the Doppler Factor for Gravitational Waves at any Position

As shown in Figure 12.4, assuming the angle between O'D and the red line is θ (where D represents any position), then

$$OD^2 = O'D^2 + OO'^2 - 2O'D \times OO' \cos\left(\frac{\pi}{2} - \theta\right), \tag{12.16}$$

get:

$$O'D = \frac{2OO'\cos\left(\frac{\pi}{2}-\theta\right) + \left[4\left(OO'\cos\left(\frac{\pi}{2}-\theta\right)\right)^2 - 4\left(OO'^2 - OD^2\right)\right]^{\frac{1}{2}}}{2}, \tag{12.17}$$

then，

$$\frac{O'B}{O'D} = \frac{2O'B}{2OO'\cos\left(\frac{\pi}{2}-\theta\right) + \left[4\left(OO'\cos\left(\frac{\pi}{2}-\theta\right)\right)^2 - 4\left(OO'^2 - OD^2\right)\right]^{\frac{1}{2}}}, \tag{12.18}$$

then，

$$f_w = \left(\frac{c+v_s}{c}\right) \times \frac{c-v_s}{v_s\cos\left(\frac{\pi}{2}-\theta\right) + \left[\left(v_s\cos\left(\frac{\pi}{2}-\theta\right)\right)^2 - \left(v_s^2 - c^2\right)\right]^{\frac{1}{2}}} \tag{12.19}$$

12.6 Gravitational Equation under the Influence of Gravitational Waves

We previously defined the contribution ratio *rw* of gravitational waves around the Sun, which represents the ratio between the gravitational force caused by gravitational waves (FGW) and the gravitational force caused by the gravitational field (FGF) without considering the Doppler effect of gravitational waves (i.e., *fw* = 1). We know that the universal gravitational constant G0 is obtained through measurements between two relatively stationary small spheres. Although the small spheres do not disturb GFEarth, we must consider their disturbance on GFSun. Therefore, G0 already includes the influence of

gravitational waves. However, we need to make a correction to G0 to remove the effect of gravitational waves.

From Table 12.1, we can obtain the Earth's gravitational ratio:

$$r_{w0} = 1.25 * r_w \tag{12.20}$$

Since we do not know the positions of the two stationary spheres, we cannot calculate *fw*. However, due to the Earth's speed being only 1/8th of the Sun's speed, the Doppler effect of gravitational waves around the spheres will be much smaller. Additionally, the current measurement precision of G0 cannot detect variations in *fw*, so we can approximate fw$\approx$ 1. Therefore, the correction to the universal gravitational constant is:

$$G_0 / (1 + r_{w0}) \tag{12.21}$$

In this way, we can separate FGW and FGF:

$$F_{GF} = \frac{G_0 Mm}{r^2} / \left(1 + r_{w0}\right), \tag{12.22}$$

$$F_{GW} = r_w \times f_w \times F_{GF} \tag{12.23}$$

Let F represent the total gravitational force on an object under the combined influence of the gravitational field and gravitational waves. We obtain:

$$F = F_{GF} + F_{GW} = F_{GF} + r_w \times f_w \times F_{GF} \tag{12.24}$$

Next, let's take the position of the planetary orbital plane as an example to illustrate the calculation of gravitational force:

$$F = F_{GF} + r_w \times f_w \times F_{GF} = F_{GF} \times \left(1 + r_w \times \left(\frac{c^2 - v_s^2}{c^2} \right)^{\frac{1}{2}} \right) \tag{12.25}$$

Since there is also a Doppler effect between the planet and the gravitational waves, we need to consider the influence of this factor as well. Let's assume the velocity of the planet is *vp*, and the velocity of the planet in the direction of the gravitational waves is *vpw*. We can calculate the Doppler factor between the planet and the gravitational waves as: $\frac{c - v_{pw}}{c}$. By incorporating this factor into equation (12.25), we can obtain:

$$F = F_{GF} \times \left(1 + r_w \times \left(\frac{c^2 - v_s^2}{c^2} \right)^{\frac{1}{2}} \times \frac{c - v_{pw}}{c} \right), \tag{12.26}$$

Substituting FGF, we obtain:

$$F = \frac{G_0 Mm}{r^2} / \left(1 + r_{w0}\right) \times \left(1 + r_w \times \left(\frac{c^2 - v_s^2}{c^2} \right)^{\frac{1}{2}} \times \frac{c - v_{pw}}{c} \right), \tag{12.27}$$

here, rw≈0.000575, which comes from computer simulation. Since the Earth's *rw0* is 1.25 times that of the Sun, we have:

$$r_{w0} = 1.25 * r_w \approx 0.00072 \tag{12.28}$$

Finally, let's write out the gravitational equation for any position:

$$F = \frac{G_0 Mm}{r^2} / \left(1 + r_{w0}\right) \times \left(1 + r_w \times \frac{c + v_s}{c} \times \left(\frac{c - v_s}{v_s \cos\left(\frac{\pi}{2} - \theta\right) + \left[\left(v_s \cos\left(\frac{\pi}{2} - \theta\right) \right)^2 - \left(v_s^2 - c^2\right) \right]^{\frac{1}{2}}} \times \frac{c - v_{pw}}{c} \right) \right) \tag{12.29}$$

Here, θ is dependent on the position of the planet and varies cyclically with time. The equation also contains the velocity term of the planet. Therefore, we can refer to equation (12.29) as the dynamic gravitational equation.

From Table 12.1, we can also calculate the gravitational ratios for other planets, as shown in Table 12.2:

Sun	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
0.000575	0.00067	0.0015	0.00072	0.00002	0.0017	0.000087	0.0000015	0.000000045

Table 12.2: Gravitational ratios contributed by gravitational waves

Next, we need to analyze whether gravitational waves will affect the conservation of mechanical energy in planetary orbits. Will they cause the planetary orbits to become unstable?

12.7 Analysis of the Conservation of Mechanical Energy in Planetary Orbits under the Influence of Gravitational Waves

In the A, B, C, and D regions of the elliptical planetary orbit, as shown in Figure 12.6, we will analyze the mechanical energy of the planetary orbits in each of the four orbital regions separately.

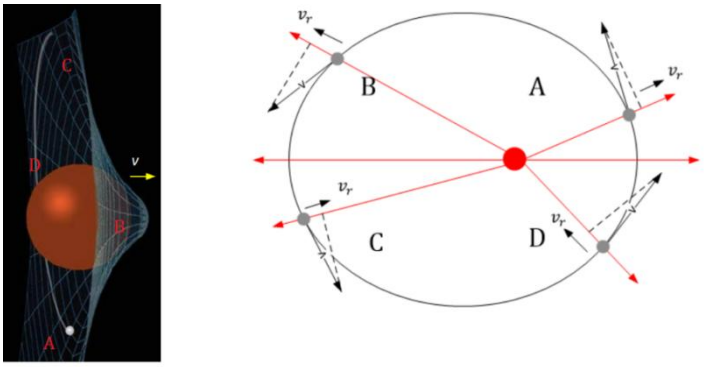


Figure 12.6: Analysis of the conservation of mechanical energy in planetary orbits.

When a planet enters the high-density gravitational wave region to the right of the ideal orbital plane in the A orbital region, the gravitational force increases. However, there is a velocity component in the direction of the gravitational field, and the added force acts in the opposite direction of the velocity ($P = F * v < 0$), resulting in a decrease in mechanical energy.

When a planet returns from the highest gravitational wave density region to the ideal orbital plane in the B orbital region, the gravitational force decreases. However, there is a velocity component in the direction of the gravitational field, and the added force acts in the same direction as the velocity ($P = F * v > 0$), resulting in an increase in mechanical energy. (A and B offset each other)

When a planet enters the low-density gravitational wave region to the left of the ideal orbital plane in the C orbital region, the gravitational force decreases. However, there is a velocity component in the opposite direction of the gravitational field, and the added force acts in the opposite direction of the velocity ($P = F * v < 0$), resulting in a decrease in mechanical energy.

When a planet returns from the lowest gravitational wave density region to the ideal orbital plane in the D orbital region, the gravitational force increases. However, there is a velocity component in the opposite direction of the gravitational field, and the added force acts in the same direction as the velocity ($P = F * v > 0$), resulting in an increase in mechanical energy. (C and D offset each other)

Conclusion: The mechanical energy of planetary orbits remains conserved under the influence of gravitational waves, and the results of computer simulations confirm this conclusion.

12.8 Gravitational Waves Caused by the Sun's Rotation

The Sun also undergoes a slow rotation around the center of mass of the solar system (approximately 15 m/s), in addition to its own rotation. These movements disturb the gravitational field and give rise to gravitational waves. However, the Sun's orbital speed of 240 km/s is much greater than its rotational speed of 2 km/s. Therefore, this physical model does not take into account the effects of rotation and other factors that may cause gravitational waves. If more precise calculations are required, we must consider these factors.

12.9 Analysis of the Influence of Gravitational Waves on Planetary Orbits

If there is an angle between the planetary orbital plane and the ideal orbital plane, the effect of gravitational waves on the planet will be uneven. This will impact the planet's orbit and contribute to the precession of the planetary orbit. The closer the planet's orbit is to the Sun, the greater the gradient of gravitational wave density on the orbit, making the precession effect more pronounced. Conversely, the farther the distance, the smaller the variation in gravitational wave density on the orbit, resulting in a less noticeable precession effect. From Figure 12.4, it can be observed that within a certain range, the larger the angle between the actual orbital plane and the ideal orbital plane represented by the vertical dashed line in Figure 12.4, the more pronounced the precession.

In 1915, [32] Einstein provided a formula for the relativistic perihelion shift. For a planetary orbit with a period

$$\varepsilon = 24\pi^3 \frac{a^2}{T^2 c^2 \left(1-e^2\right)}, \tag{12.30}$$

where T is the orbital period of the planet, e is the eccentricity of its elliptical orbit, a is the length of its corresponding semi-major axis, and c is the speed of light in vacuum.

$$\delta\varphi = \varepsilon \frac{\tau}{T} \frac{180}{\pi} 3600'' \tag{12.31}$$

Here, τ = 3155814954 s represents the number of seconds in a century. General relativity (GR) constructs an idealized 1-Body model, where the influence of the planet's gravity on the Sun is ignored when calculating the planetary precession. As seen from the above formula, GR also does not consider the angle between the planetary orbital plane and the ideal orbital plane shown in Figure 12.4. Additionally, equation (12.30) shows that the smaller the eccentricity of the orbit, the smaller the precession. This contradicts the classical theory viewpoint that a smaller eccentricity leads to a more unstable orbit. Under the 1-Body model, we calculated the orbital precession data for the eight major planets in

the solar system based on the precession equation provided by GR [33], as shown in Table 12.3.

We applied the dynamic gravitational equation and also calculated the orbital precession for each planet, providing comparative data in Table 12.3 (we did not neglect the influence of the planet's gravity on the Sun, but from the calculation results, the influence of the planet's gravity on the Sun can be ignored). We can see that without taking into account the effects of gravitational waves (i.e., considering only the gravitational force produced by the gravitational field), the planetary precession is zero. This is consistent with the conclusion that the spatial curvature caused by mass cancels out in 3D space, resulting in the straight propagation of the gravitational field. If we include the effects of gravitational waves, the planetary precession in the 1-Body system is in close agreement with the results calculated by GR, except for Venus. (The precession data in the paper are calculated by projecting the precession at the perihelion onto the x-y plane.)

Condition	Planet	GW off	GW on	GR
1-Body	Mercury	0	43	41.06
	Venus	0	169	8.6
	Earth	0	0.35	3.83
	Mars	0	-5.6	1.34
	Jupiter	0	-1.35	0.062
	Saturn	0	-0.33	0.0136
	Uranus	0	0.1	0.00238
	Neptune	0	-0.64	

Table 12.3: 1-Body Planetary orbital precession (" per century)

Let's take a look at the characteristics of Venus: Venus has an unusually low eccentricity (e = 0.0068), making its perihelion highly sensitive to small perturbations. However, its orbit has a relatively large angle (3.39°) with respect to the ideal orbital plane. Therefore, we have reason to believe that gravitational waves will have a significant impact on the orbital precession of Venus. However, it would be inappropriate to draw conclusions based solely on the inconsistent orbital precession data for Venus calculated using the dynamic gravitational equation in the 1-Body model (169" per century) and the data obtained from

GR calculations (8.6" per century). Later, we will compare the orbital precession of each planet calculated using the N-Body system with astronomical observation data provided by NASA.

We know that the famous 43" precession deviation of Mercury comes from the comparison between the calculated planetary orbit data of the solar system using Newtonian classical mechanics and astronomical observation data [34]. This requires calculating the gravitational forces among all the planets in the solar system, the forces between the planets, and the Sun's rotation around the center of mass of the solar system. This involves constructing a realistic N-Body system and then calculating the planetary precession data with and without the influence of gravitational waves. From the data in Table 12.4, we can see that the orbital precession data for the eight major planets are relatively close to the astronomical observations. In particular, for Venus, without considering the effects of gravitational waves, the orbital precession deviates significantly from the astronomical observations. However, when the effects of gravitational waves are included, the orbital precession of Venus aligns more closely with the astronomical observations. (The initial coordinates (x, y, z) and initial velocities (vx, vy, vz) of the planets and the Sun used in this study are obtained from NASA's Horizon system [35]).

Condition	Planet	GW off	GW on	NASA(E-I-H)
N-Body	Mercury	531	570 ~ 572	575
	Venus	-270 ~ -120	200 ~ 270	204
	Earth	1080 ~ 1160	1140 ~ 1170	1145
	Mars	1560 ~ 1600	1560 ~ 1600	1628
	Jupiter	600 ~ 1000	600 ~ 1000	655
	Saturn	1600 ~ 2200	1600 ~ 2200	1950
	Uranus	140 ~ 600	140 ~ 600	334
	Neptune			36

Table 12.4: N-Body Planetary orbital precession (” per century)

Here, it is important to note that the astronomical observation data provided by NASA is obtained by fitting the real planetary data measured by satellites using computer calculations in the E-I-H equation model. In particular, the planetary orbital precession

undergoes significant variations in each orbital period, and the data provided by NASA are averages calculated over a long period of time. Additionally, it should be emphasized that the orbital periods of the eight planets in the solar system are very long, making it challenging to derive the orbital precession patterns for planets with very small eccentricities through short-term calculations. Even with 200 years of astronomical observations, we cannot obtain the orbital precession patterns for all planets. It requires even longer observation times to obtain statistically averaged data. However, for Mercury and Mars, which have relatively large eccentricities, we can approximate general patterns through calculations or astronomical observations within a relatively small number of planetary cycles.

12.10 Detection of Gravitational Waves near Earth's Orbit

From Table 12.2, it can be seen that the contribution of gravitational waves around the Sun to solar gravity is 0.000575, which is a significant value. Can we measure the gravitational waves around the Sun on Earth? From Table 12.4, it can be seen that the influence of gravitational waves on Earth's orbit is very small, meaning it is difficult to detect the effects of gravitational waves around the Sun on Earth. This is because Earth's orbital plane is nearly coincident with the ideal orbital plane, and the contribution of gravitational waves to solar gravity remains almost unchanged. It would be a good choice to conduct gravitational wave detection around the Sun on planets with larger orbital inclinations, such as Mercury (7°) and Pluto (17.4°).

12.11 Dynamic Universal Gravitation

General relativity defines the gravitational field and describes the nature of space-time. The gravitational field exhibits the static characteristics of space-time, which is consistent with the description of the gravitational field in Newton's law of universal gravitation. However, gravitational waves demonstrate the dynamic characteristics of space-time, complementing Newton's law, which only considers "static characteristics." The combined effect of the gravitational field and gravitational waves leads to the emergence of dynamic universal gravitation equations, which yield accurate results in planetary orbit calculations that are consistent with general relativity (E-I-H equations). The dynamic gravitational equation also serves as a verification of the existence of gravitational waves.

Under the same physical model (Xton), we have established a unified field theory encompassing electric, magnetic, and gravitational fields. We now understand that gravity does not originate from attraction, but rather from the combined force of opposing tensions formed by surrounding xtons. Therefore, the question arises: can we generate

reverse xton tensions through certain measures to cancel out gravity, thereby eliminating it? This holds significant importance for human exploration of the universe. Next, let us contemplate how to eliminate gravity.

Chapter 13
How to Eliminate Gravity

According to the unified field theory based on xton, the xtons between two celestial bodies form a balancing relationship due to being simultaneously squeezed in opposite directions by the bodies, resulting in a "relaxed" tension. This creates a thrust force around the bodies that pushes them towards each other. Under the influence of this thrust, the two celestial bodies appear to be attracting each other. Therefore, the key to eliminating gravity lies in rebalancing the surrounding xton tensions. Let's use a spacecraft as an example to illustrate how to make the spacecraft no longer subject to the gravitational pull of the Earth.

According to the unified field theory, electric charges generate electric fields, which are the longitudinal energy of xton vortices. These vortices exert a thrust force on the surrounding xtons. Based on Newton's third law, which states that forces act on each other, the surrounding xtons also exert an opposite force on the vortices, creating a reverse xton tension.

If this reverse tension is large enough, it can create a sufficient force to counteract gravity and even propel the spacecraft away from the Earth. Now, how do we generate a sufficiently large reverse tension? We have devised such a design:

Place a circular, rotatable metal plate at the bottom of the spacecraft. Use a high voltage to accumulate enough charges at the bottom of the spacecraft, thereby generating a sufficiently strong electric field. This electric field can create a sufficiently large reverse tension on the xtons beneath the metal plate. However, it is difficult to ensure the stability of the spacecraft in this manner, so we can make the plate rotate to achieve a stable reverse xton tension that counteracts gravity. As shown in Figure 13.1.

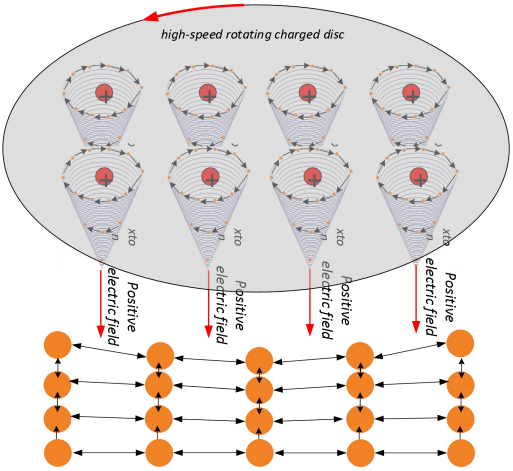


Figure 13.1: High-Speed Rotating Charged Disk

Using electric field force to cancel out gravity, this experiment is not complicated. In fact, the phenomenon that electric fields can propel the movement of objects has long been discovered.

13.1 Light Moves Objects

Light can propel objects through radiation pressure, a phenomenon believed to be based on the transfer of momentum from photons to the surface of objects. In space engineering, the Solar Sail is a typical example that utilizes this principle. The solar sail propels spacecraft by utilizing the radiation pressure exerted by sunlight on a large surface area. Since the 1980s, many space flight missions testing solar propulsion and navigation have been proposed. The first spacecraft to utilize this technology was the IKAROS launched in 2010, as shown in Figure 13.2.

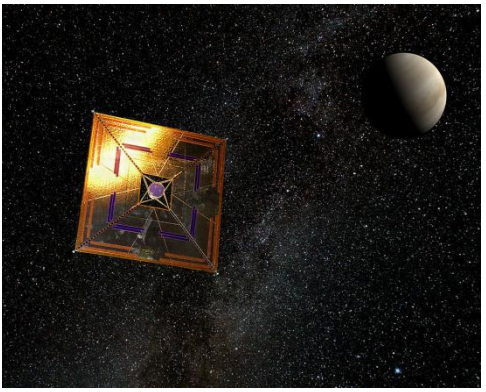


Figure 13.2: IKAROS, the first space-probe with a solar sail in flight (artist's depiction), featuring a typical square sail configuration of almost 200 m^2

The force exerted by light on a large surface is similar to a ship's sail being blown by the wind. High-energy laser beams can be used as an alternative light source to apply greater force than using sunlight, a concept known as laser sailing. Solar sails offer the possibility of low-cost operations, high speeds (relative to chemical rockets), and long operational lifetimes. Because they have almost no moving parts and do not require propellant, they can be used multiple times for payload delivery.

Solar pressure affects all spacecraft, whether in interplanetary space or orbiting planets or small celestial bodies. For example, a typical spacecraft bound for Mars will experience displacements of thousands of kilometers due to solar pressure, requiring this influence to be considered in trajectory planning, a practice ongoing since the earliest interplanetary missions from the 1960s. Solar pressure also influences the orientation of spacecraft, a factor that must be considered in spacecraft design.

For instance, at the distance between Earth and the Sun, the total force exerted on an 800 x 800-meter (2,600 x 2,600-foot) solar sail is approximately 5 N (1.1 pounds), making it a low-thrust propulsion system similar to spacecraft propelled by electric thrusters. This force, almost continuously applied due to the absence of propellant, can be significant over time, serving as a potential means to propel spacecraft.

Solar sailcraft typically consist of lightweight, reflective films that utilize radiation pressure from sunlight to provide propulsion. When sunlight shines on the sail's surface, photons exert pressure on it, transferring momentum to the sailcraft and propelling it. This propulsion method differs from traditional rocket propulsion as it does not require fuel for propulsion but relies on solar energy to provide thrust. The speed of a solar sailcraft depends on the intensity of sunlight and the area-to-mass ratio of the sailcraft. Despite radiation pressure being relatively small, in the absence of resistance in space, solar sailcraft can gradually accelerate and achieve long-distance travel.

In addition to space applications, the concept of radiation pressure can also be observed in experiments on Earth. For example, by shining a laser beam on tiny particles to observe their movement. The phenomenon of light propelling the movement of objects can be seen as a good confirmation of the longitudinal energy (electric field) of xton eddy

currents acting as a thrust on surrounding xtons, thereby propelling objects to move.

13.2 History of Photonic Propulsion Research

Johannes Kepler observed that the tails of comets pointed in the direction away from the Sun and attributed this phenomenon to the Sun. In a letter he wrote to Galileo in 1610, he stated, "Provide ships or sails adapted to the heavenly breezes, and there will be some who will brave even that void." Though his publication on comet tails came a few years later, he might have been thinking about this phenomenon when he penned those words.

James Clerk Maxwell published his electromagnetic field and radiation theory between 1861-1864, which indicated that light possesses momentum and can exert pressure on objects. Maxwell's equations provided the theoretical foundation for utilizing radiation pressure for propulsion. By 1864, the physics community and other fields knew that sunlight carries momentum and can exert pressure on objects.

Jules Verne wrote in his 1865 work "From the Earth to the Moon": "Some day, some way, we will be able to harness speeds far greater than theirs, using some kind of mechanical force—light or electricity...Some day, we will travel to the moon, to the planets, and the stars." This might be the first acknowledgment in print that light could propel a spacecraft through space.

Peter Lebedev successfully demonstrated radiation pressure for the first time using a torsion balance in 1899; in 1901, Ernest Nichols and Gordon Hull conducted similar independent experiments using a Nichols radiometer.

In 1908, Svante Arrhenius predicted that solar radiation pressure could spread life spores between stars, providing a way to explain panspermia. He was apparently the first scientist to propose that light could move objects between stars.

Konstantin Tsiolkovsky first proposed using sunlight pressure to propel spacecraft through space and suggested "using huge mirrors made of very thin sheets to achieve cosmic velocities."

Friedrich Zander published a technical paper in 1925 that included a technical analysis of solar sails. Zander wrote about applying "light pressure or transferring light energy to a distance through very thin mirrors" to "apply small forces."

In 1927, John B. S. Haldane conceived of inventing tubular cosmic ships to send humans into space and imagined "unfurling metal foil wings the size of a square kilometer or larger to capture solar radiation pressure."

J.D. Bernal wrote in 1929: "It may be possible to develop a method of space navigation by the repulsive force of sunlight rather than by wind. A spaceship could spread its immense metallic wings to several acres, then be blown to the limits of Neptune's orbit. Then, to increase speed, it would sail against the wind, against the gravitational field, and then open its sails again when flying past the sun."

Arthur C. Clarke penned the sci-fi short story "The Sunjammer," initially published in the March 1964 issue of Boys' Life, depicting a yacht race between solar sail spacecraft.

In the 1970s, Carl Sagan popularized the idea of using giant structures for photon sailing, which would reflect photons in one direction to generate momentum. He presented his ideas in university lectures, books, and television programs. He was eager to launch this spacecraft quickly to rendezvous with Halley's Comet in time but unfortunately, the mission was not completed on schedule, and he did not live to see it through.

The first formal technical and design work on solar sails began in 1976 when the Jet Propulsion Laboratory was working on a mission to rendezvous with Halley's Comet.

13.3 Ion Propulsion Aircraft

American physicist Thomas Townsend Brown proposed the Biefeld–Brown effect, which uses high voltage-generated electric fields to make objects levitate. The principle involves using a high-voltage electric field to ionize the surrounding air, creating an ion flow that generates an upward reaction force. This is evidently different from the principle of using xton eddy currents to provide thrust.

Ion propulsion aircraft are a type of aircraft that utilizes electrohydrodynamics (EHD) to provide lift or thrust in the air, without the need for combustion or moving parts. Such aircraft have been designed. As shown in Figure 13.3, current designs are not yet capable of generating enough thrust for manned flight or carrying significant payloads.

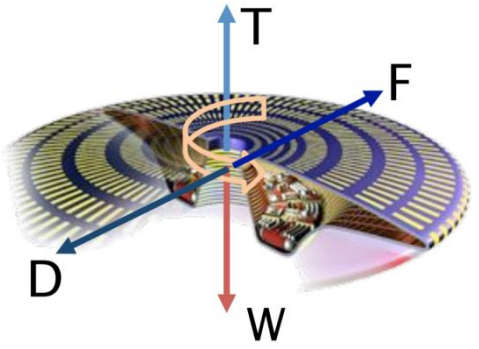


Figure 13.2: EHD Aircraft

In November 2018, the first self-sustained ion propulsion fixed-wing aircraft, the MIT EAD Airframe Version 2, flew 60 meters. It was developed by a student team led by Steven Barrett at the Massachusetts Institute of Technology (MIT). The aircraft has a wingspan of 5 meters and weighs 2.45 kilograms. It is launched using a catapult launcher, with the EAD (Electrohydrodynamics) system supporting the aircraft in low-altitude flight. Similar aircraft still rely on traditional technology, needing the presence of surrounding air for propulsion; they would lose power in a vacuum environment.

To achieve rapid and enduring interstellar travel, utilizing light or electric fields to propel spacecraft is a more effective method.

Chapter 14
Double-Slit Interference Experiment

Two years ago, I attempted to explain the double-slit interference experiment but was unsuccessful, so I shelved it. It wasn't until recently that I completed my research on the Faraday experiment and the Saginac effect, and I have incorporated these findings into this book. Next, I began researching the double-slit interference experiment. It is intriguing; quantum mechanics theory provides an explanation based on the "complementarity principle," but it seems more like a "recitation" of this experimental phenomenon because this principle does not unravel the mystery of the double-slit interference experiment. Therefore, revealing the truth of wave-particle duality is not only challenging but also an interesting endeavor. At the same time, the double-slit interference experiment is also a good test of the xton unified field theory.

The double-slit interference experiment is one of the classical and important experiments in optics, and we have delved into this experiment and related theories in depth. Initially, we introduced the basic principles of the double-slit interference experiment and the mechanism behind the formation of interference fringes. Subsequently, by analyzing the interference experiment of individual particles, we discussed quantum mechanics' explanation of the interference phenomenon of single particles, leading to the concept of wave-particle duality. Furthermore, we explored the "which-way" experiment and the complementarity principle, elucidating the contradictory nature of photons possessing both particle-like and wave-like properties.

Additionally, classical wave optics formulas were introduced to explain the generation of interference fringes and how to calculate their positions. In terms of the fundamental structure of the electromagnetic field of light, the crucial role of the electric field in the formation and propagation of light was emphasized. The energy of the electric field directly propels the propagation of light (detailed explanations were provided in the previous section "Source of Light Energy"). The misconception that classical electromagnetic waves propagate through the alternating induction of electric and magnetic fields was addressed.

Moreover, a thorough analysis of electromagnetic induction phenomena was conducted, establishing an electromagnetic wave model akin to a clock spring, providing a vivid

illustration of the interconversion of energy between electric field and magnetic field (detailed explanations were provided in the previous section "Electric Field and Magnetic Field"). Finally, the interference phenomenon exhibited by single particles in experiments was explained, combining the fundamental structure of the electromagnetic field, the new electromagnetic wave model, and the theory of wave optics to unveil the physical mechanisms behind the interference characteristics displayed by particles in experiments. This study provides an important reference for theoretical research and experimental exploration in the fields of optics and quantum physics.

Furthermore, we placed the chapter on the double-slit interference experiment at the end of the book, hoping that through this experiment, which Feynman considered as "containing the only mystery" of [quantum mechanics], we could test whether the xton-based unified field theory is correct. Therefore, we did not directly use the conclusions from the previous chapters to explain the double-slit interference experiment. Next, let us gradually unravel this "mysterious" experiment.

14.1 Introduction to Double-Slit Interference Experiment

In modern physics, the double-slit experiment demonstrates that light and matter can exhibit behaviors of both classical particles and classical waves. In 1801, Thomas Young first conducted such experiments to prove the wave behavior of visible light. In 1927, Davisson and Germer, along with George Paget Thomson and Alexander Reid, respectively demonstrated that electrons also exhibit the same behavior. See Figure 14.1.

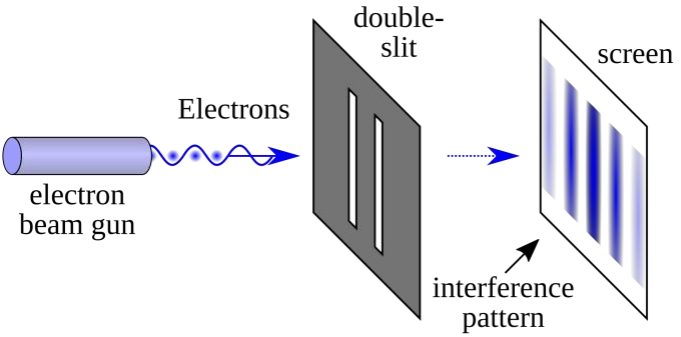


Figure 14.1: When using two narrow slits, photons or matter (such as electrons) will produce interference patterns.

In the basic version of this experiment, a coherent light source (such as a laser beam) is directed onto a plate pierced by two parallel narrow slits, and the light passing through the

slits can be observed on a screen placed behind the plate. The wave nature of light causes interference between the light waves passing through the two slits, resulting in the formation of bright and dark bands on the screen - a result that wouldn't occur if light were composed of classical particles. However, we observe that light is always absorbed on the screen in the form of discrete points, behaving as individual particles (rather than waves); the interference pattern arises from the different densities at which these particles strike the screen. (If you have already read the "Electric Field and Magnetic Field" chapter, you will not be surprised by this phenomenon. The longitudinal energy (electric field) manifested by xton vortices represents particle-like behavior, while the transverse energy (magnetic field) represents wave-like behavior.)

Later, the double-slit experiment was extended to atoms and molecules[5][6][7][8], although as the size of the objects increased, so did the difficulty of the experiment. The largest objects to undergo the double-slit experiment were molecules, each composed of 2000 atoms (with a total mass of 25,000 atomic mass units). The double-slit experiment (and its variations) has become a classic because it vividly expresses the core difficulties of quantum mechanics. Richard Feynman referred to it as "an impossibility in any classical explanation of the phenomenon, which contains the heart of quantum mechanics. In fact, it contains [the] only mystery [of quantum mechanics]." In other words, quantum mechanics is full of unknowns.

14.2 Interference Experiment with Single Particles

In the electron double-slit interference experiment, multiple particles are simultaneously directed towards the double slits, which may result in interference from interactions between different particles passing through different slits. This is a possibility that readily comes to mind. To eliminate this possibility, a single-particle interference experiment was conducted. [46]When a low-intensity electron beam is directed through the double slits, individual particles are detected as white spots on the screen. However, it is worth noting that when these particles are allowed to accumulate one by one, an interference pattern emerges (see Figure 14.2 below). This means that electrons continue to exhibit particle behavior upon reaching the screen, but the pattern formed by the accumulation of particles seems to suggest that the particles transform into waves after passing through the double slits.

For photons, which are electromagnetic waves, we can provide the following explanation: When photons pass through the double slits, they may split into two parts, thereby

creating interference. However, for electrons, the possibility of being split into two parts by the double slits is zero.

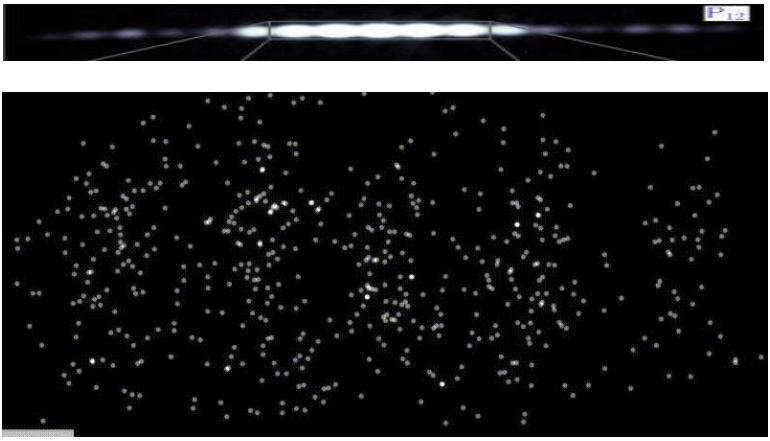


Figure 14.2: Experimental electron double-slit diffraction pattern. In the middle of the top image, the intensity alternates from high to low, indicating interference of signals from the two narrow slits. Bottom: Pattern constructed point by point.

"Even when a low-intensity electron beam is directed through the double slits, there is still a possibility that multiple electrons are reaching the slits, leading to a suspicion that interference might occur between these electrons. In 2012, Stefano Frabboni and his colleagues sent individual electrons through nano-fabricated slits (approximately 100 nanometers wide) and were able to observe the formation of the double-slit interference pattern by detecting the transmitted electrons using a single-electron detector."[47]

The single-particle experiment rules out the possibility of interference caused by interactions between multiple particles. "This seems to further prove the wave-particle duality," that is, all matter exhibits both wave and particle characteristics: particles are measured as individual pulses at specific positions, while the square of the modulus of the wave describes the probability of detecting particles at particular positions on the screen, thereby creating statistical interference patterns.

Wave-particle duality is a well-established concept in quantum mechanics theory. How does wave-particle duality explain the double-slit interference experiment? Quantum mechanics theory suggests that when unobserved, particles behave as waves when passing through the double slits and then manifest as particles upon reaching the screen. However, when observed, the wave function collapses, and the particle no longer exhibits

wave-like behavior. While this explanation is plausible as a hypothesis, it is not considered scientifically rigorous. Relying solely on speculation or assumptions to construct a theory is unwise, which is why research on wave-particle duality experiments continues.

Nevertheless, it is undeniable that in various experiments, matter does exhibit both particle-like and wave-like properties. Therefore, it is imperative to understand why matter can demonstrate both particle-like and wave-like behavior and to elucidate the underlying physical mechanisms behind this phenomenon.

To determine whether photons or electrons are split into two paths, a straightforward method is to observe whether they pass through both slits simultaneously or only through one slit. This is known as the "which-way" experiment.

14.3 "Which Way" Experiment and Complementarity Principle

According to classical wave theory, the presence of two wave sources is necessary to create interference. Therefore, it is speculated that when photons or particles pass through the double slits, they split into two paths. Hence, it becomes necessary to clarify whether photons or particles, at a given moment, pass through which slit or whether they simultaneously pass through both slits due to splitting. Experimental versions involving detectors installed at the slits reveal that each detected photon passes through only one slit (as classical particles would), rather than simultaneously through both slits (as waves would). Such experiments indicate that if particles are detected passing through a specific slit, they will not produce an interference pattern. The reason for this may be the disruption of the interference scenario. Alternatively, an explanation can be provided using the Complementarity Principle proposed by quantum theory, which states that photons can exhibit particle-like or wave-like behavior but not both simultaneously. In other words, when not observed, photons behave as waves, and when observed, they behave as particles. The Complementarity Principle only restates the observed phenomena; it is only a phenomenon. To elevate it to a principle, the first possibility, "interference scenario being disrupted," needs to be ruled out.

Scientists have proposed the wave-particle duality of matter and introduced the Complementarity Principle. These concepts seem more like restatements of the phenomena observed in the double-slit interference experiment, thus requiring further experiments for verification.

[48][49][50][51][52][53][54][55]Scientists have conducted some refined experiments, including the delayed-choice experiment and quantum eraser experiment. The results of these experiments support the Complementarity Principle, which states that photons can exhibit both wave-like and particle-like behavior. These experiments to some extent rule out the possibility of "interference scenario being disrupted," but they have not completely eliminated this possibility. The cloud hanging over quantum theory has yet to dissipate.

The importance of the Complementarity Principle in quantum mechanics is no less significant than the principle of the constancy of the speed of light in special relativity. When we measure or record which slit a photon passes through, this introduces path information into the experiment. According to the principles of quantum mechanics, determining the path of the photon leads to the collapse of the wave function, thus eliminating the possibility of interference. In this case, the photon will exhibit more traditional particle-like characteristics and will no longer display interference patterns. This explanation is more rooted in "speculation and imagination." Therefore, it might be more appropriate to refer to the "Complementarity Principle" as the "Complementarity Phenomenon," but the "Complementarity Phenomenon" is indeed a real experimental observation.

Therefore, the prerequisite for testing the "Complementarity Principle" of quantum theory with the "which-way experiment" is the complete elimination of the possibility of "interference scenario being disrupted."

Is there a possibility that after passing through the slits, the direction of the photon has already changed, aligning it with the direction of the interference pattern? In this scenario, regardless of which slit the photon passes through, it would not affect the formation of the interference pattern. Is such a possibility feasible? In other words, we need to understand if the propagation direction of the photon changes after passing through the double slits. If it does change, how does the new direction establish a connection with the interference pattern? We will start unraveling this mystery starting from the classical theory of double-slit interference of light.

14.4 Classical Wave Optics Formulas

In the double-slit experiment, two narrow slits are illuminated by a laser beam of

quasi-monochromatic light. If the width of the slits is sufficiently small (much smaller than the wavelength of the laser), the slits will diffract light into cylindrical waves. These two cylindrical waves overlap, and the amplitude (intensity) at any point in the combined wavefront depends on the amplitudes and phases of the two wavefronts. The phase difference between the two waves is determined by the difference in the distances traveled by the two waves. See Figure 14.3.

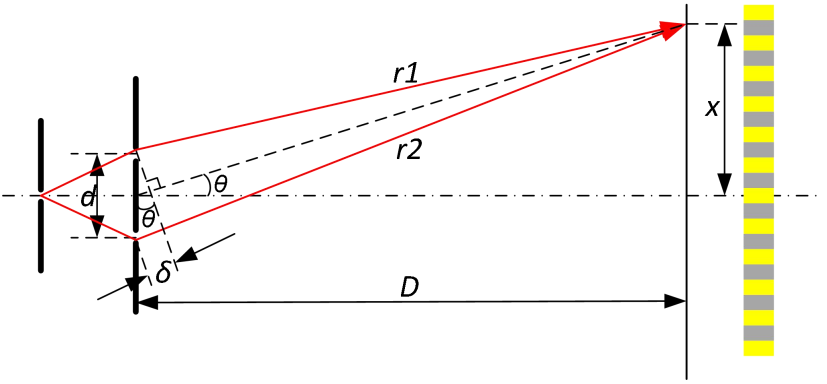


Figure 14.3: Double-slit interference of light

First, calculate the optical path difference δ between the two beams of light:

$$\delta = r_1 - r_2 \tag{14.1}$$

When δ satisfies

$$\delta = \pm k * \lambda, k = 0,1,2,... \tag{14.2}$$

Interference strengthens, producing two fringes. When δ satisfies

$$\delta = \pm(2k-1) * \frac{\lambda}{2}, k = 0,1,2,... \tag{14.3}$$

Interference weakens, resulting in dark fringes. Next, calculate the positions of the bright and dark fringes, x, based on geometric relationships.

$$\tan\theta = \frac{x}{D} \approx \frac{\delta}{d} \tag{14.4}$$

Because θ is very small, equation (14.4) is approximately equal. Thus, we obtain:

$$x \approx \frac{\delta}{d} * D \tag{14.5}$$

Substitute (14.3) into (14.5) to obtain the position of the bright fringe:

$$x \approx \pm k * \lambda * \frac{D}{d}, k = 0,1,2,... \tag{14.6}$$

Substitute (14.3) into (14.5) to obtain the position of the dark fringe:

$$x \approx \pm(2k-1) * \frac{\lambda}{2} * \frac{D}{d}, k = 0,1,2,... \tag{14.7}$$

Most behaviors of light can be modeled using classical wave theory. The Huygens-Fresnel principle is one such model; it states that each point on a wavefront generates a secondary wavelet, and the disturbance at any subsequent point can be found by summing the contributions of all the secondary wavelets at that point. This summation involves considering the phases and amplitudes of the individual wavelets. Only the intensity of the light field can be measured—it is directly proportional to the square of the amplitude. We have previously analyzed in the study of light reflection and refraction that the Huygens-Fresnel principle is not a physical truth[56], but it can be used for calculations. Based on the Huygens-Fresnel principle[57][58], we obtain the interference effects shown in Figure 14.4.

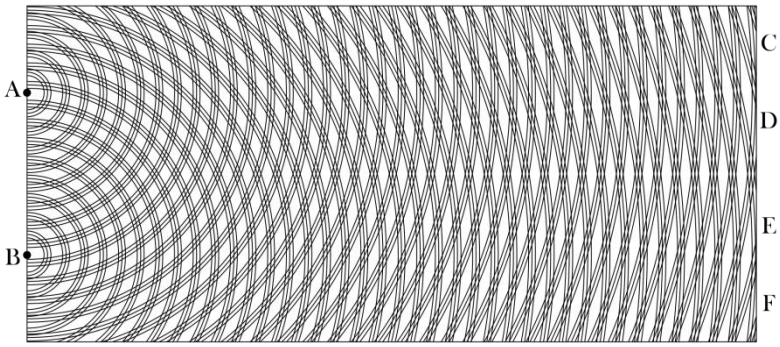


Figure 14.4: Interference Pattern of Light through Double Slits

This classical wave optics theory can very easily explain the interference phenomenon that occurs when light passes through double slits. As long as there are two sources of waves with the same frequency but different positions, the waves will interfere with each other. But how do we explain single-photon or single-particle interference experiments? It seems impossible to explain single-particle interference experiments using classical wave theory. However, we know that interference patterns are closely related to the wavelength of

electromagnetic waves associated with particles. This suggests that electromagnetic waves play a crucial role. This compels us to understand the fundamental structure of electromagnetic waves.

We tirelessly reintroduce the fundamental structure of electromagnetic waves because it is crucial. If you do not understand that "the electric field plays a decisive role in the formation and propagation of light, the energy of the electric field directly propels the propagation of light, and the speed of electric field propagation determines the speed of light propagation in a vacuum," then you may not be able to correctly understand various optical experiments and optical phenomena.

14.5 Basic Structure of Electromagnetic Waves

Visible light is a high-frequency electromagnetic wave, and it is quite challenging to artificially generate a segment of visible light wave point by point in the time domain. However, generating low-frequency electromagnetic waves in the time domain is relatively easy. Therefore, studying low-frequency electromagnetic waves can clearly demonstrate the details of light in the time domain, thereby revealing the source of energy propagation of light. We know that the electric field under different voltage conditions will produce different electric field strengths and distributions. The electric field is caused by charges, and when a voltage is applied to a charged object, a corresponding electric field is formed. The electric field strength is directly proportional to the voltage. Therefore, by changing the voltage, we can alter the strength and distribution of the electric field.

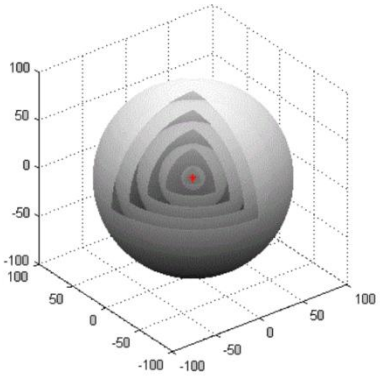


Figure 14.5: Propagation of Light in the Form of Spherical Waves

The electric field propagates outward in the form of spherical waves, as shown in Figure 14.5, with its intensity directly proportional to the voltage. Therefore, the curve of the

electric field intensity change exhibits the same waveform as the curve of the voltage change. At any point in space, the intensity of the electromagnetic wave varies with time. We use bright and dark fringes to describe the changes in electric field intensity, where bright fringes represent strong electric field intensity and dark fringes represent weak electric field intensity. The changing electromagnetic field exhibits alternating bright and dark fringes, as shown in Figure 14.6. When the frequency is within the range perceptible by the human eye, it becomes visible light.

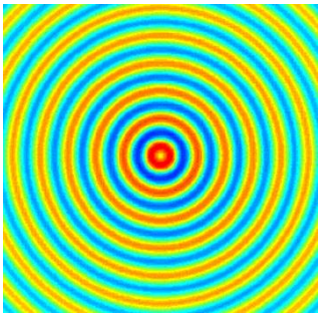


Figure 14.6: Bright and Dark Fringes Caused by Variations in Electric Field Intensity

Therefore, it can be determined that the electric field plays a decisive role in the formation and propagation of light. The energy of the electric field directly drives the propagation of light. Furthermore, the propagation speed of the electric field determines the speed of light propagation in a vacuum. In essence, a photon is actually a fluctuating electric field.

However, classical physics tells us that electromagnetic waves propagate through the alternating induction of electric and magnetic fields, as shown in Figure 14.7.

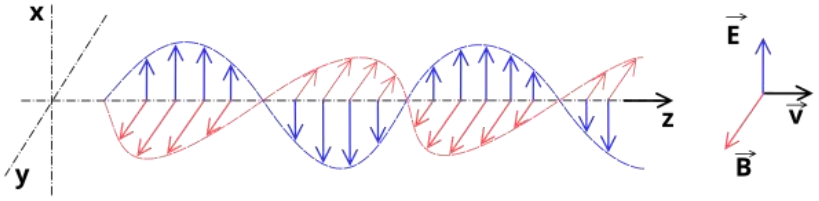


Figure 14.7: Classical Electromagnetic Wave Model

According to the law of electromagnetic induction, the magnitude of the magnetic field reflects the rate of change of the electric field, rather than the magnitude of the electric field. The classical model shown in Figure 14.7 is clearly incorrect. In the illustration, when the electric field reaches its maximum value, the rate of change of the electric field is at its minimum, so the magnetic field should also be at its minimum, rather than at its maximum.

When the electric field crosses the z-axis, at this point, the slope of the curve is at its maximum, indicating that the magnetic field should reach its maximum, rather than its minimum.

Taking a simple example, according to the classical model shown in Figure 14.7, as the electric field gradually increases, the magnetic field also increases. When the electric field reaches its maximum value and stops changing, according to this model, the magnetic field would also reach its maximum value and remain constant. This clearly violates the law of electromagnetic induction and does not align with reality. However, this erroneous electromagnetic field model is widely referenced and used in teaching.

Here is a story: When I pointed out that the classical electromagnetic wave model was incorrect, my university professor was very surprised, even angry. However, the next day he found me and said that I was right. After that, he never discussed the topic again.

Another error in Figure 14.7 is that the direction of the electric field should not be perpendicular to the direction of propagation of the electromagnetic wave but should be in the same direction. The electric field curve in the figure only reflects the intensity variation of the electric field. We should not mistakenly interpret the direction of vibration of the electric field energy as the propagation direction of the electric field. This is a mistake made by the classical electromagnetic wave model. The direction of the magnetic field is also incorrect; the magnetic field's direction should be tangent to a circular plane perpendicular to the path of the electromagnetic wave. The curve representing the magnetic field intensity in the figure only reflects the intensity variation of the magnetic field. Furthermore, the phase difference between the intensity variation curves of the magnetic field and electric field should be 90 degrees. It is hoped that these errors will draw the attention of colleagues in the field.

So why does the propagation of an electric field induce a magnetic field around it? We cannot simply say, "That's just how it is." This is not rigorous science; we need to understand why a changing electric field induces a magnetic field and why a changing magnetic field can also induce an electric field. This is of crucial importance for us to decipher the double-slit interference experiment.

14.6 Electromagnetic Induction

According to the law of electromagnetic induction [59][60][61][62], a changing electric field will induce a magnetic field around it, as shown in Figure 14.8:

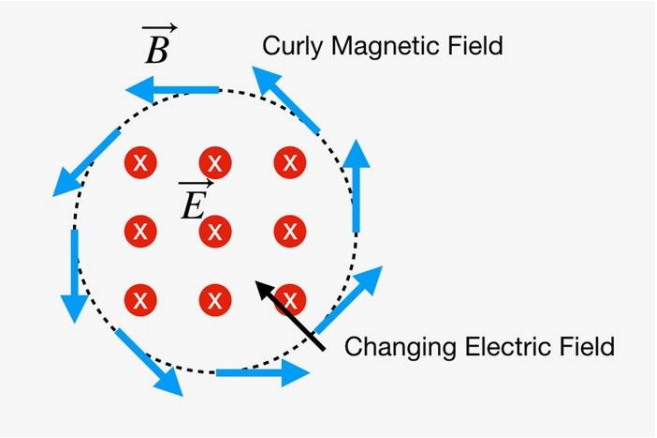


Figure 14.8: A periodically changing electric field generates a periodically changing magnetic field.

Conversely, a changing magnetic field will induce an electric field in its surroundings, as shown in Figure 14.9.

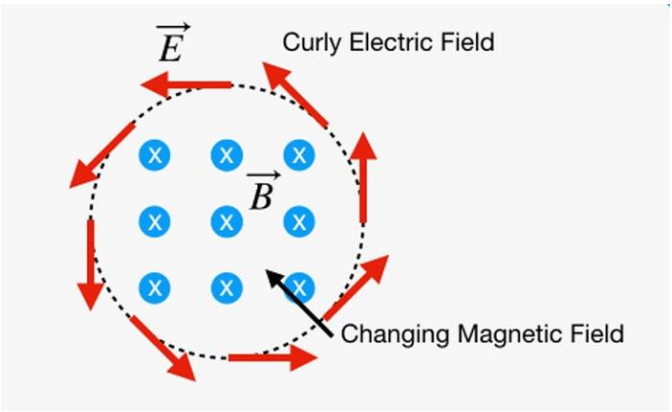


Figure 14.9: A periodically changing magnetic field generates a periodically changing electric field.

Regarding electromagnetic induction and the interaction between charges, as well as the interaction between magnetic fields, we have already provided a detailed analysis in the previous "Electric Field and Magnetic Field" chapter.

Since we are studying electromagnetic waves, which propagate in the same direction as the electric field, we have chosen the model shown in Figure 14.8 for our analysis. The electric field propagates in a straight line, and changes in the electric field induce a magnetic field in its surroundings. When the electric field remains stable, regardless of its magnitude, the magnetic field will be zero. This is a phenomenon we have observed. Now, from the perspective of energy, let's assume that changes in the electric field cause variations in some kind of potential energy, and the magnetic field reflects the rate of change of this potential energy. Since the plane of the magnetic field is perpendicular to the electric field, we can establish a mechanical model akin to a wind-up alarm clock spring to illustrate how the electric and magnetic fields in electromagnetic waves work. As shown in Figure 14.10:

Figure 14.10: Clock spring

Let's first analyze the spring mechanism of a clock. Initially, the spring is in a naturally extended and static state, with no force applied to it. Next, we apply a constant force F to wind the spring. After a period of time T, the elastic force of the spring equals F, and the spring returns to its static state. During this period T, the greater the change in the force F acting on the spring (from 0 to F), the faster the spring winds up, the quicker the potential energy of the spring changes, and the faster the elastic force of the spring varies. In other words, the faster the potential energy of the spring changes (i.e., the faster the deformation of the spring changes), the faster the spring winds up and the quicker the elastic force changes.

If the winding force F remains constant, the spring will stop winding when its elastic force equals F. If F increases, the spring will continue to tighten, increasing its elastic potential energy. If F decreases, the spring will relax, releasing its elastic potential energy.

In summary, since the elastic force of a clock spring is directly proportional to its deformation, the rate of change of the force F acting on the spring determines the speed

of winding and the rate of change of the elastic potential energy of the spring.

It can be seen that this is very similar to the phenomena exhibited by electric and magnetic fields. The energy of the electric field is equivalent to the external energy used to wind up a spring, while the energy of the magnetic field, which we commonly refer to, is actually the angular kinetic energy of the magnetic field, akin to the angular kinetic energy of a wound-up spring. The magnetic potential energy, which we often overlook, is equivalent to the elastic potential energy of the spring. When the force generated by the electric field energy balances the force generated by the magnetic potential energy, the magnetic field (angular kinetic energy) disappears. The faster the electric field changes, the greater the angular kinetic energy of the magnetic field, and vice versa.

Therefore, the spring model can effectively describe the interaction between electric and magnetic fields. Based on the clock spring, we have established an electromagnetic wave model as shown in Figure 14.11. Here, we have introduced an unknown substance, xton vortex, to replace the clock spring.

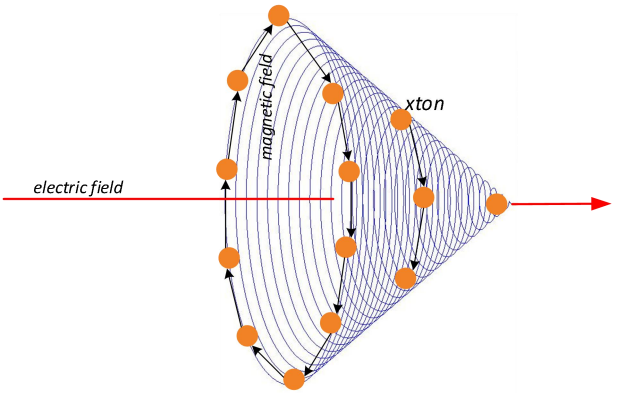


Figure 14.11: Electromagnetic Wave Model Based on Clock Spring Mechanism (Xton Vortex)

For a more detailed description of the xton vortex model, you can refer to the "Electric Field and Magnetic Field" chapter mentioned earlier.

In this way, we have defined a new electromagnetic wave model. Therefore, it can be imagined that if the "internal dynamic balance" formed by the electric and magnetic fields of a propagating electromagnetic wave (photon) is disrupted, the direction of the photon's velocity may change.

Understanding these basic structures of electromagnetic waves and electromagnetic

induction phenomena is crucial for explaining single-particle interference experiments.

14.7 Explanation of Interference Experiment with Single Particles

Classical wave optics theory tells us that interference requires two wave sources of the same frequency but at different locations. Clearly, a single particle cannot be split into two parts, meaning the idea of obtaining two wave sources by splitting a particle can be discarded. We already know that light is electromagnetic waves, and a changing electric field induces a magnetic field, with the electric field that transfers energy forward surrounded by a magnetic field. From the perspective of the electric field, a photon is a short segment of linearly propagating electric field energy, which exhibits particle-like properties when it reaches a screen. However, from the perspective of the magnetic field, the surrounding of an electric field particle is a magnetic field energy wave. When passing through a double-slit, these magnetic field energy waves form the two wave sources of the same frequency that we are seeking. The magnetic field waves interfere with each other, forming interference energy that affects the electric field, causing the "internal dynamic balance to be disrupted" and changing the direction of the photon. This change is highly correlated with the interference energy of the photon's magnetic field. Therefore, when a photon passes through a double-slit, its direction has already changed, and the new direction is influenced by the interference waves of the magnetic field.

The same principle applies to electrons and molecules; however, compared to photons, electrons and molecules possess electromagnetic waves of higher frequencies. Therefore, photons, electrons, and molecules exhibit particle-like properties in their direction of propagation, but the surrounding magnetic fields exhibit wave-like properties. It is therefore not surprising that "after passing through a double-slit, they are always absorbed in the form of discrete points on the screen, becoming individual particles (rather than waves), and interference fringe patterns appear."

A significant reason why the double-slit interference experiment has long been without a reasonable explanation is the influence of the incorrect classical electromagnetic wave model, as shown in Figure 14.7, on people's thinking.

14.8 Interesting Ideal Experiment - Farmer's Observation

Here is an interesting thought experiment as well. A farmer uses a very advanced telescope to observe particles (electrons, atoms, molecules) passing through which slit in a

particle double-slit interference experiment located 1 km away. However, the scientists conducting the particle interference experiment are unaware that someone 1 km away is observing the experiment. So, can the farmer and the scientists observe the particle interference pattern in the end? Will the result be like this: because the farmer 1 km away observes the path of the particles, the wave function of the particles collapses, making it impossible for the farmer to observe the particle interference pattern, but the scientists can observe the double-slit interference experiment because they do not know the particle paths. Furthermore, if the farmer calls the scientists and tells them the path of the particles, can the scientists still observe the particle interference phenomenon at that time?

14.9 Summary of Double-Slit Interference Experiment

To study light, we must first understand its basic structure, Understand how the magnetic field and electric field interact with each other. We cannot focus solely on electric fields while ignoring magnetic fields; they are inseparable. We have pointed out that the classical electromagnetic field model is incorrect and established an electromagnetic field model based on the clock spring mechanism. Although electromagnetic fields and clock springs may seem unrelated, they are remarkably similar in terms of energy conversion. We have introduced an unknown particle, Xton, which we have also incorporated into studies of the Fizeau experiment, light reflection, refraction, stellar aberration, the Sagnac effect, as well as gravity and gravitational waves. We must acknowledge the fact that the physical model based on Xton provides an excellent explanation for the physical mechanisms behind light and gravity in the universe. [63]

"The collapse of the wave function" is a phrase that appears very mystical. As a description of a phenomenon, I think it is acceptable, but as an explanation of a physical phenomenon, it is obviously not rigorous.

One of the main reasons that has long perplexed the world in the double-slit interference experiment is the incorrect understanding of the model of electromagnetic waves. The classical model of electromagnetic waves is flawed.

The energy that drives electromagnetic waves comes from the electric field. The direction of the electric field is the same as that of light, and the electric field is a form of longitudinal energy transfer. Surrounding the changing electric field is a changing magnetic field, with magnetic field lines perpendicular to the path of particles. Magnetic field waves interfere at the double slit, and this interference affects the propagation path of particles.

Therefore, the double-slit interference experiment can be easily explained.

The double-slit interference experiment holds profound importance in the establishment of quantum physics. This experiment is a significant milestone in the history of quantum mechanics. Richard Feynman described it as "a phenomenon that cannot be explained in any classical way and contains the core of quantum mechanics. In fact, it contains the only mystery [of quantum mechanics]." Now that this mystery has been unveiled, we do not intend to offend the principles of quantum mechanics; rather, we have provided reasonable analysis and derivation. We hope our research can stimulate thought and further investigation among our peers.

14.10 Some Discussions on Electromagnetic Waves

After completing my research on the double-slit interference experiment, I noticed Professor D.M. from the University of Bethlehem, who has in-depth research in theoretical physics and quantum physics. Therefore, we had an exchange through RG. As our conversation deepened, I found that the topics we discussed were of a general nature. Therefore, I decided to summarize our discussion. I believe that one of the most effective means of advancing science is through discussion and debate. Without these, our thinking would stagnate.

This is the text I started sending to the professor: "Dear Professor, a few years ago, I also attempted to explain the double-slit interference experiment. It wasn't until this year when I completed the unified field theory that I revisited this experiment and found it very easy to explain. This experiment has long been considered one of the most mysterious in physics, partly due to the incorrect classical electromagnetic wave physics model. I hope to discuss this issue with you." Later, at the professor's request, I provided the following supplement:

1. The key to explaining the double-slit interference experiment is understanding the fundamental structure of light.
2. The classical electromagnetic wave model is incorrect, as detailed in my paper, see Chapter Five "Basic Structure of Electromagnetic Waves."
3. The energy driving light comes from the electric field, and the direction of light propagation is the same as the electric field. There is a magnetic field surrounding the electric field, with the magnetic field planes perpendicular to the light path. When the energy of the electric field changes periodically, the surrounding magnetic field also changes periodically.

4. The periodically changing magnetic field constitutes a magnetic wave, which interferes at the double slits, thereby affecting the propagation direction of the electric field.
5. Therefore, when a photon passes through any slit, the interference of the magnetic wave causes a change in the photon's propagation direction. This change is closely related to the interference of the magnetic wave.
6. Higher frequency magnetic waves exist around electrons, atoms, and molecules. Therefore, these magnetic waves ultimately cause particles to change their propagation direction when passing through the double slits.

Later, we delved into this "lengthy" discussion. I briefly summarized some of the professor's viewpoints:
1. Electric fields do not propagate spontaneously in any direction. Instead, they oscillate in specific directions.
2. Magnetic fields also oscillate transversely and do not have a propagating component.
3. What propagates in space is the energy of electromagnetic waves, which is transmitted through the interaction of oscillating electric and magnetic fields. Electric and magnetic fields do not propagate as independent entities.
4. The electric field in static electricity decays, whereas the electric field in electromagnetic waves does not decay when propagating in a vacuum. This fact indicates that these are two entirely different phenomena. It is a fundamental mistake to confuse static electric fields (as described by Coulomb's law) with the dynamic fields involved in the propagation of electromagnetic waves.
5. The extension of the electric field and the implications of propagation are synonymous. Extension: Refers to the field spanning the area around a source, such as the static electric field around a charge. This field does not move but exists as a force field in space. Propagation: Refers to fields that transmit energy and information through space, as in the case of electromagnetic waves. Here, the oscillations of the electric and magnetic fields are coupled together to form propagating waves.

For this discussion, I wrote the following paragraph:
"When a static and stable electric charge generates an electric field that propagates (or extends), in the spatial region at the leading edge of the electric field, due to changes in the electric field, according to the electromagnetic induction law, a magnetic field will be induced at this leading edge. This means that whenever a stable electric field propagates (or extends), a magnetic field will always accompany its leading edge. The electric field propagates outward in straight lines forming an electric field path. In other positions along

this path (apart from the leading edge), where the electric field no longer changes, no magnetic field is induced in the surroundings. However, once the electric field changes (for example, due to a change in charge), a magnetic field will be induced along the electric field path. This changing electric field is what we commonly know as electromagnetic waves. A stable electric field can be considered as an electromagnetic wave with a frequency of 0, and the propagation direction of the electric field is the propagation direction of the electromagnetic wave. I believe the above analysis is very logical and aligns well with reality. I am unsure why the classical electromagnetic wave model became the mainstream viewpoint; it is fundamentally flawed. Based on the viewpoints provided by the professor, I can only say they seem to be in a state of confusion."

The professor mentioned another mainstream viewpoint: the electric field in static electricity decays, while the electric field in electromagnetic waves does not decay when propagating in a vacuum. This fact indicates that these are two entirely different phenomena. This still surprises me as a wireless communication engineer.

We know that in wireless communication systems, wireless signals propagate in all directions through antennas in the form of spherical waves, and signal attenuation is mainly caused by geometric expansion (based on the inverse square law). The electric field generated by charges also propagates (or extends) in the form of a spherical field, which is no different from the "geometric expansion" attenuation of electromagnetic waves. This can be seen from Coulomb's law.

$$F = \frac{k \mid q_1 q_2 \mid}{r^2} \tag{14.8}$$

Apart from the "geometric expansion" factor, where the electric field weakens as the distance r increases (14.8), there are no other attenuation factors. If the electric field can be focused into a beam, eliminating the "geometric spreading" factor, then the electric field would not decay in a vacuum, similar to an ideal laser beam.

Therefore, the mainstream viewpoint that states "the electric field in static electricity decays, while the electric field in electromagnetic waves does not decay" is highly erroneous.

As for whether the electric field propagates, the professor initially believed that the electric field does not propagate; it only extends. He considered propagation and extension as distinct concepts. He provided the following definitions:

Extension: The static electric field (such as a field around a charge) spans the space around it. It does not move but simply exists.
Propagation: Electromagnetic waves propagate by transmitting energy and information in space, with the electric and magnetic fields oscillating perpendicular to each other.

According to these definitions, I am very curious to know how the electric field reaches a certain position if it does not move. For example, how does the electric field generated by a charge at point A reach point B, 1000 meters away? Does it appear instantaneously? I do not understand how the professor would explain this.

Later, the professor mentioned that "the electric field only oscillates in specific directions." So, what is the relationship between the oscillation and extension that he mentioned? I am shocked by the confusion in mainstream electromagnetic wave theory. Perhaps, as a professor adhering to mainstream viewpoints, they are "competent."

Discussion is a highly effective research tool. To bring facts to light, one needs to disrupt the calm surface. Truth can be overshadowed and ignored amidst praise and admiration, which is detrimental to the advancement of human science.

Finally, I summarize the electromagnetic waves based on Xton's unified field theory:
1. The direction of the electric field is the forward direction of the Xton vortex.
2. The electric field reflects the tension potential of the Xton vortex.
3. The magnetic field reflects the rotational kinetic energy of the Xton vortex.
4. Fluctuations in the energy of the electric field will produce bright and dark fringes. When the frequency of these fringes falls within the visible range of the human eye, it forms the light that we perceive. The direction of propagation of the electric field, that is, the direction of the vortex's advance, is the direction of light propagation.

"Electric fields and magnetic fields cannot propagate independently; they can only vibrate.“ If this viewpoint aligns with Maxwell's equations, then I can only say that Maxwell's equations can describe dynamic electric fields but cannot describe static electric fields (i.e., electromagnetic waves with a frequency of 0). This is consistent with Professor D.M.'s viewpoint. However, I believe this statement is still incorrect. Stable electric fields can propagate, but in this scenario, no magnetic field is generated around the stable electric field. Therefore, the magnetic field is not a prerequisite for the propagation of the electric field; rather, the magnetic field is a 'by-product' that arises during the propagation

of a changing electric field.

Chapter 15
Conclusion

We have established a unified physical model based on xton to study the most common light and gravitational phenomena in the universe. According to this model, we can explain the electric field, magnetic field, gravitational field, gravitational waves, and the internal structure of charges effectively. The dynamic gravitational equations based on this model have been well verified in the calculation of planetary orbital precession in the solar system. Experiments such as light refraction, reflection, the Fizeau experiment on light propagation in moving media, the Sagnac effect experiment, the double-slit interference experiment, and others all indicate the existence of xton. Xton plays a crucial role in energy transmission in the universe, serving as the most important and fundamental particle in the cosmos. The unified field theory based on xton also lays a theoretical foundation for overcoming gravity, which is of significant importance for humanity's exploration of the universe and venturing into deep space.

However, this theory also poses challenges to both special relativity and general relativity. The history of human scientific development is very brief, and exploration into unknown realms has never ceased. We must approach things with a developmental perspective. It is precisely because of the efforts of those who came before us that we have the opportunity to stand on the shoulders of giants and analyze problems from a more comprehensive perspective. Scientific progress should not stagnate in the theories of any one scientist; rather, it should be more inclusive of questioning and challenging existing views and encourage young scientists to boldly challenge mainstream authoritative theories, thereby driving the continuous development of science.

This theory poses challenges to both classical physics theories and quantum mechanics theories. Particularly, errors in classical physics theories must be corrected promptly, or they can seriously mislead people's thinking. Quantum theory still harbors various unknowns, but the direction of quantum theory is correct. We are on the right path, and the unified field theory based on xton can be seen as the development of quantum theory. To unravel the mysteries of the universe, we must understand the microscopic structure of the cosmos. Any theory based on speculation is "dangerous"; we must clarify the physics mechanisms behind phenomena. Hopefully, our research can actively promote the

development of quantum theory.

Since 2020, we have been studying universal gravitation, encountering several setbacks along the way. With the help and encouragement of esteemed individuals such as Professor Richard Fitzpatrick from the University of Texas at Austin, Professor Michal Krizek from the Czech Academy of Sciences, Academician Li Tipei from the Center for Astrophysics at Tsinghua University, Professor Andrew Beckwith from the United States, Professor Валентин Настасенко from Ukraine, Dr. Mustafa Khan from the United States, Dr. Nadeem Haque from Canada, Dr. Cynthia Whitney from the United States, Dr. Reiner Georg Ziefle from Germany, Dr. Arne Kjellman from Sweden, and Alchemist Newton After Blake from the United Kingdom, we have persisted in our efforts and finally completed the book "The Physics Mechanisms Behind Light and Gravity in the Universe." I express my heartfelt gratitude to them here.

Lastly, we must also express our gratitude to great scientists such as Isaac Newton (1643), Thomas Young (1773), Carl F. Friedrich Gauss (1777), Edward Morley (1838), Albert A. Michelson (1852), Hendrik Antoon Lorentz (1853), Albert Einstein (1879), Richard Feynman (1918), and others. They have paved the way for us in the realm of science, and our duty is to continue laying that path. Only by venturing beyond the solar system into the vast universe to explore our new home further can humanity have the chance for eternity.

The Voice of Scientists:

Dear Tony Yuan,

Many thanks for your story of 9 May.

My own life experience was this: I did a PhD thesis on SRT in the MIT Physics Department.

Then I went looking for a permanent job, across the street at MIT Draper Lab.

They showed me the Sagnac effect, as part of the guidance and control system for the Apollo program.

I saw, and they already knew, that the Sagnac effect was sure & certain death for SRT!

When I showed the problem to my Physics Prof., he saw it too.

But Einstein was, and still is, a fund-raising icon for Physics.

So many Physicists still do defend the indefensible in SRT.

Engineers are better listeners. Mathematicians are too.

We have a society here called 'Natural Philosophy Alliance'.

China probably has like-minded people too.

I hope you can find them.

CKW

Dear Tony Yuan,

...

My personal experience was this: I did my whole education at MIT:

SB Physics, SM EE, PhD Physics.

My PhD thesis was about using quaternion algebra in SRT.

Then I went to a job at Draper Lab, then part of the MIT Aero Dept.

There, they were working on the Apollo program, going to the Moon.

Nobody at Draper believed in SRT. And they were so right!

There really is a big problem with SRT.

When I told My PhD thesis supervisor, he apologized profusely!

He had suspected that Physics did have some big problems.

But he had thought that SRT, at least, was safe!

CKW

I am not an expert on astronomy so I cannot answer your question whether your calculations are right. But since 5 out of 6 answers are correct ... there are good reasons to assume also your Venus-computation is correct. But since I have worked with GR for 50 years now - I can assure this theory is misleading. So, we are stuck in the classical problem - we know THAT GR is misleading - but not HOW. But we will find out some day!
This problem in fact has stalled all science --- we know THAT it doesn't work - but cannot yet say HOW .... This is a serious scientific problem ... the sciences refuse to address the issue of theirs own impotencies. This attitude is called Ockham's razor - or refusing to cut down the sick branch you yourself are sitting on.
However --- children know how to solve this problem - jump off the branch first and cut it down afterwards!
Best wishes ... Arne

You are very likely correct about GRT --- but back to Newton is unfortunately a disaster ... There are other ways -- but I think it would be dangerously unwise do discuss this matter via email ....
Best

I am a mathematician and system developer. Interested in science, mostly number theory, cosmology, history, the special theory of relativity, SR. Since 2016 I have been working with SR, have analyzed: - the Michelson-Morley experiment; - The derivation of Lorentz Transformations, LT, from various college courses or books; - Verified various mathematical models that are published in the literature regarding SR; All my work with SR leads to the conclusion that SR is nonsense.
Jan Slowak

Professor Richard, one of the most formidable physics professors I know, based on several years of discussions with him. He highly appreciates my work but advised me to give up. I once hoped he would be a reviewer for my paper. His response has already illustrated the current state of physics today.
Dear Tony
I cannot be a referee, because I have a clear conflict of interest.
Richard

My email to professor Robert B. Laughlin:

Dear professor,

I saw a passage about you on Wikipedia:

In 2005, Robert B. Laughlin (Physics Nobel Laureate, Stanford University), wrote about the nature of space: *"It is ironic that Einstein's most creative work, the general theory of relativity, should boil down to conceptualizing space as a medium when his original premise [in special relativity] was that no such medium existed ... The word 'ether' has extremely negative connotations in theoretical physics because of its past association with opposition to relativity. This is unfortunate because, stripped of these connotations, it rather nicely captures the way most physicists actually think about the vacuum. ... Relativity actually says nothing about the existence or nonexistence of matter pervading the universe, only that any such matter must have relativistic symmetry."*

Professor Li Tipei from Tsinghua University in China also excerpted some words about Einstein.

"I have studied the problem of gravitational waves... I admit to you that general relativity is closer to the ether hypothesis than special relativity... This "guv" state of the ether... is a function that depends on the position of material processes." - "To Lorentz" (June 17, 1916)

"According to general relativity, space has been endowed with physical properties... A space without ether is inconceivable: light cannot propagate, and standards of space and time cannot exist, so there is no physical meaning to spacetime intervals." - "On the General Theory of Relativity" (1920)

"Einstein is a guy who only cares about his own convenience, overturning what he said the previous year every year."

To Pal Fhrenfest, December 1915.

"My series of papers on gravity is a chain of errors." - "To Lorentz" (January 1916)

When interviewed, the American Academy of Sciences academician, Shiing-Shen Chern, said that *"Einstein's theory is incorrect, and Einstein's mathematics is very poor."*

In our era, professors who dare to question Einstein's theory are rare, but the voices of questioning have never ceased. I am Tony, a former wireless communication engineer at Motorola, where I worked in research and development for 10 years. At the end of 2020, I

began researching gravity, and for the following years, I dedicated myself to this research, which eventually extended to light. I analyzed experiments and astronomical observations on light over the past few hundred years from an engineer's perspective.

I believe there are errors in Einstein's theory, and that aether is the correct direction. I have written my theory in a book titled "Physical Mechanisms Behind Light and Gravity in the Universe." One of Einstein's mistakes is based on the Michelson-Morley Experiment (MMX) and the assumption of the constancy of the speed of light, which I find to be a hasty move. A completely aether-dragging theory can explain MMX and stellar aberration very well. The constancy of the speed of light has long been refuted by the Sagnac effect experiment.

Another error of Einstein is assuming that the speed of gravity equals the speed of light. A slow gravity speed would lead to gravitational delay, making the orbits of celestial bodies in the solar system unstable. I conducted simulations on a computer and verified my idea: the speed of gravity must be much greater than the speed of light for the orbits to be stable.

Furthermore, the concept of mass bending spacetime is illogical. Space is 3D, so which side of space around the Earth would bend towards it? Up, down, left, right? In my view, physics has become a playground for the ignorant.

As you have mentioned, the aether, accurately summarizes most physicists' true views on the vacuum. Through a review and study of experiments on light and astronomical observations over the past few hundred years, we have proposed a unified field theory based on the aether (which we call XTON). It can explain gravity fields, gravitational waves, electric fields, and magnetic fields very well.

I have attached my book, which you can also download on ResearchGate: [Unified Field Theory: Physical Mechanisms Behind Light and Gravity in the Universe] https://www.researchgate.net/publication/381319341_Unified_Field_Theory_Physical_Mechanisms_Behind_Light_and_Gravity_in_the_Universe

I would be very pleased to receive your reply, although I think the probability is about the same as winning the lottery. However, I will indeed await the email like a child eagerly anticipating candy from their parents.

Thank you for reading.
Merry Christmas.

Kind regards,
Tony

I'm not so sure it was Einstein who expressed that the aether did not exist when he introduced his special theory of relativity. He gave the impression that an aether was not necessary to explain the null-result of the Michelson - Morley experiment, but I don't think he expressed himself in such a direct way that an aether did not exist. Over time, other people did that for him. All that the null-result showed was that the Earth's motion around the Sun had no impact on the speed of light. However, later in life, Einstein expressed himself more clearly. He gave an address on 5 May 1920 at the University of Leiden. He chose as his topic "Ether and the Theory of Relativity. " Here are the concluding remarks of his speech.
Recapitulating, we may say that according to the general theory of relativity space is endowed with physical qualities; in this sense, therefore, there exists an ether. According to the general theory of relativity space without ether is unthinkable; for in such space there not only would be no propagation of light, but also no possibility of existence for standards of space and time (measuring-rods and clocks), nor therefore any space-time intervals in the physical sense.

Doctor of Philosophy From Norway

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